METAL INDUSTRY

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Aluminium in Packaging

LAST year in the United Kingdom more than 30,000 tons of aluminium were consumed by the packaging industry and the field of application is still growing. Prominent among the properties of the metal which render it particularly suitable for packaging are impermeability, appearance, low weight, formability, ease of joining and its resistance to attack by chemicals and foodstuffs. Thus, most substances lying within the *p*H range 6 to 8·5—and some outside it—do not attack aluminium nor can it impart colour, flavour or smell to substances packed in it. But, as pointed out by more than one contributor to the Symposium on Packaging organized by the Aluminium Development Association, many materials are available to the user of packages and while aluminium can well hold its present position in competition with other packaging materials, wider acceptance depends very largely on a reduction in costs.

Cost, as compared with tinplate, is the main reason why aluminium sheet is not used for making built-up containers. Even if the present price differential were to disappear, however, it is probable that the greater strength of tinplate would still lead to its continued use for those containers, such as paint cans and biscuit tins, that have to withstand handling and appreciable distortion forces. On the other hand, for shallow-formed containers, caps and closures, tinplate has no advantage over aluminium, apart from price. At present prices, the success of aluminium sheet in the closure field is undoubtedly due to its technical advantages—both in processing and in use. Its scrap value, as compared with that of tinplate, must, however, be taken into consideration when comparing prices. Thus, in the case of sheet 0·010 in. thick, aluminium costs 37 per cent more than tinplate on an area basis. Assuming a scrap allowance of 25 per cent and a scrap aluminium value of £140 per ton, the differential over tinplate is reduced to approximately 21·5 per cent.

While this price difference exists, however, it appears essential to seek outlets for aluminium in fields where tinplate has some disadvantage, such as, for instance, small diameter containers, particularly with high length/diameter ratios, for which impact extrusion is an ideal manufacturing method. The use of impact extruded aluminium tubes in place of glass tablet bottles, particularly in the small unit pack, offers weight reductions of more than 80 per cent and as much as 64 per cent greater utilization of shelf and storage space. In certain sections of the aerosol field, too, for small packs, for products depending on attractive appearance for sales, and for pressurized products demanding very strong containers there is promise of a worthwhile demand.

In common with tinplate, glass and certain forms of plastics containers, aluminium, except as foil, is at present economically acceptable as a packaging medium only when considered in relation to long production runs or when high packing costs can be sustained. Its wider use lies not so much in the greater sale of existing types of container but rather in the extension of its use to different fields. No one material is likely ever to dominate the packaging field in future and, indeed, the composite wrap—combining the virtues of aluminium with those of other materials—could be more fully exploited. There is no doubt, however, that there would be a marked increase in the usage of aluminium for all kinds of packaging, if only the producers could substantially decrease the cost of aluminium sheet.

Out of the MELTING POT

Single Thought

IF, for the sake of argument (and it would be a very protracted argument with very probably a negative outcome), you should decide to embark on the production of titanium by an electrolytic process and should then undertake a search through the patent literature, you might—should you decide to start with titanium nitride as the raw material—find a little difficulty in choosing between two such patented processes. One of these is a process which comprises electrodepositing titanium on a cathode in a fused bath of alkali metal halide, or alkaline earth metal halide, or alkali metal fluotitanate, or mixtures of the same, from a consumable anode comprising titanium nitride and recovering titanium from the cathode so that both the electrodeposition and the recovery of the titanium are carried out under such conditions that contamination of the titanium deposit by oxygen, nitrogen and adventitious impurities is avoided. The other process comprises preparing a fused salt bath consisting essentially of at least one alkali metal halide salt and containing up to 25 per cent by weight of a halide of titanium, maintaining the fused bath under an inert atmosphere, providing solid titanium nitride as the source of titanium in said bath, said titanium nitride being connected anodically to an electrolyzing circuit which includes said fused bath, passing an electrolyzing current through the said fused salt bath, and thereby electrolytically decomposing the titanium nitride with resulting evolution of nitrogen gas and deposition of titanium metal from said fused salt bath, maintaining the evolved nitrogen gas apart from the deposited titanium metal, and recovering the resulting cathodically deposited titanium metal.

Getting Off

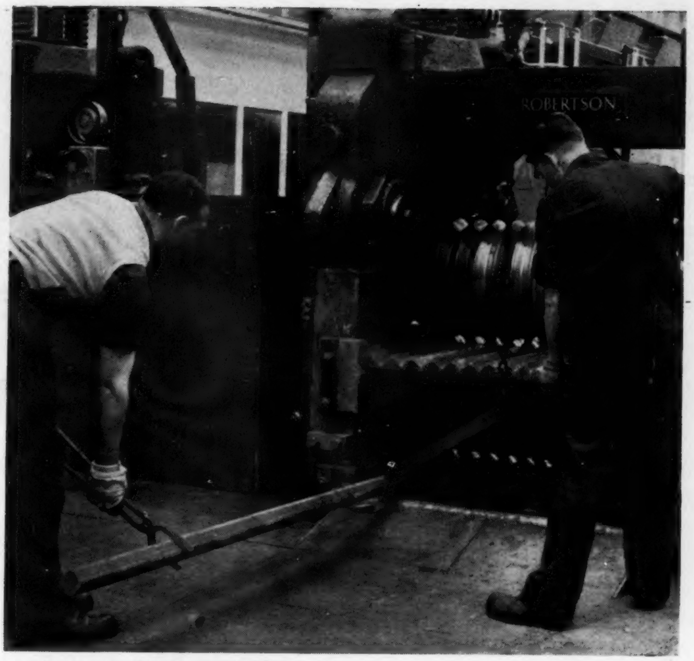
FORECASTING of business, market, production or other trends owes an enormous debt of gratitude to the fact that history does not repeat itself. This means that any forecast can only once be shown up to be wrong and can, therefore, on such an occasion, be regarded as a mistake which, like the particular bit of history to which it relates, will not repeat itself. Forecasting can thus manage to survive unscathed one mistake after another, each one of which can be of a magnitude that, were the mistake a deduction from the most plausible scientific theory, would be sufficient to consign that theory to the scrap heap of the history of science. Take, for example, the forecast of the demand for coal in this country for 1957. It was estimated that there would be an increase of between 2 and 3 million tons in demand, whereas, in fact, there occurred a fall of over 5 million tons. In spite of this shattering mistake, the forecasting business will undoubtedly go on quite unshattered, the very reasonable assumption being made that the mistake will not repeat itself, though—there ought, perhaps, to be added—other mistakes will certainly be made. Basically, the trouble with such forecasts is that they are not, in fact, true forecasts. To give them their due, they are quite soundly reasoned deductions from one given set of conditions to another set of conditions, the latter being arrived at by assuming what *should* reasonably be done given the first set of conditions. It is in this sound reasoning, and in this assumption of a reasonable course of action that the strength of such forecasting lies and the readiness with which it is accepted is to be sought. What such forecasting does not, and, in fact, if it is to remain reasonable, cannot take into account is what, given the initial set of conditions, will actually be done. And it is, of course, what is done that leads to a situation which may be radically different from that which had been forecast, and which would have been arrived at if what should have been done had, in fact, been done. Fortunately, as has already been pointed out, the non-recurrent nature of events continues to save forecasting by limiting its mistakes to individual occasions, each one of which it is, therefore, reasonably possible to forgive and forget.

Beyond Control ?

METALLURGISTS striving to understand and get under control the last few variables of minor importance in the conventional open-ended-die continuous casting process may well take a more cheerful view of their lot on learning of a process for the continuous casting of metal filaments or strips having a width from 1·8 to 5,000 microns, a thickness of 4·0 to 100 microns, and a length of from 1 micron to infinity. Basically, the process involves impinging a high speed jet of molten metal on to the surface of a rapidly rotating chill block on which the metal solidifies, and from which it is then thrown by centrifugal force. The jet of molten metal is obtained by ejecting the metal under pressure, and at a suitable temperature, from a nozzle of some refractory material such as silicon carbide with an orifice of, for example, 30 microns. The velocity of the jet may be of the order of 75 to 150 ft/sec. The chill block, on to which the jet is made to impinge, consists of a metal disc rotating about a vertical axis. The upper surface of the disc is concave (usually spherical) and has a very smooth finish (roughness less than the thickness of the filament to be produced). The chill block is rotated at from 10,000 to 30,000 r.p.m. to produce surface speeds (at the point of impingement) of up to 1,000 ft/sec. The jet of molten metal, at the right degree of superheat (to control surface tension) and at the right ejection speed, is arranged to impinge on the concave surface of the chill block at a suitable angle and at a point at which the surface speed of the block has the required value. The chill block is made sufficiently massive to enable it to take up the heat given up by the solidifying metal during a continuous run. Those skilled in the art will appreciate that the nature of the cast product will be determined by all the factors referred to above working together. For example, keeping everything else constant, and increasing the speed of impingement has the effect of decreasing the thickness of the continuous cast filament until a point is reached at which the filament ceases to be continuous. If the speed is increased still further, the length of the discontinuous filaments is gradually reduced, until a point is reached at which the cast product becomes, in effect, a flake powder. The above changes occur in reverse:—flake powder—discontinuous filaments—continuous filament of increasing thickness — if the speed of impingement is kept constant and the ejection velocity of the jet of molten metal is gradually increased.

Skinner

Titanium Rod and Sheet



Feeding bar to Robertson rod-rolling mill

WROUGHT titanium products are produced by the Metals Division of Imperial Chemical Industries Ltd. at their Waunarlwydd works in South Wales. The plant is complementary to the 2,000 tons/annum titanium melting plant at Witton, Birmingham, and comprises a rod plant and a sheet plant.

The factory is laid out with two adjacent heavy bays, housing the rolling equipment for rod and for sheet, separated by a short distance from two light bays, one housing the rod finishing equipment and the other the sheet finishing equipment. A completely enclosed lean-to bay on the light building contains the pickling equipment.

Metals Division Engineering Department undertook the bulk of the design work, but a firm of contractors, H. K. Ferguson (Great Britain) Ltd. was appointed to supervise the construction work on site. Work began on site on February 1, 1956. Steel work was erected, starting from the office end using a mobile crane, and this was followed closely by roofing and painting contractors. Norstel scaffolding bridges were erected in each bay to allow the overhead work to be done quickly and safely while erection of plant continued on the floor. The heavy building and offices were ready for occupation in February, 1957, and the first production rolling started in March, only 13 months after the work began. Production was increased as more plant became available, sheet production being in full operation in June last year and rod production in December with the completion of the rod rolling mill.

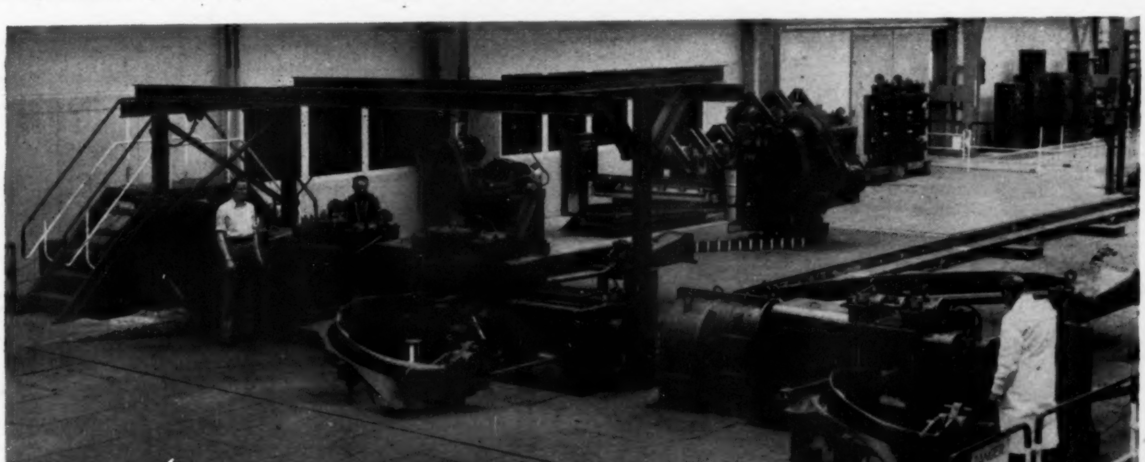
The two buildings are of portal frame design. The main units (rafters, Y-pieces and columns) were welded and ultrasonically tested *in situ*. The building is clad with I.C.I. "Kynalok" aluminium, fitted with perspex roof lights. All the bays have overhead cranes, the crane tracks for which were thermit welded into single lengths.

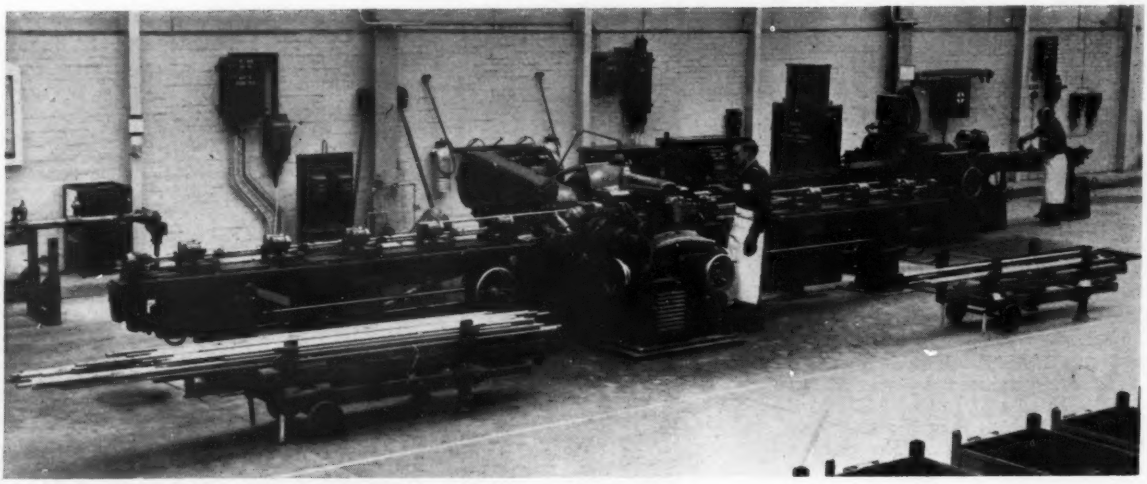
Rod Plant

The main product of the rod plant is rolled round bar and rod, lathe turned, centreless turned or centreless ground, in all I.C.I. alloys, in diameters from about 5 in. down to 0·250 in., but the plant is also suitable for the production of simple rolled sections. The capacity of the rod plant is of the order of 1,500 tons/annum.

The starting stock consists of forged

Morgardshammer five-stand guide mill for finishing rod down tc 0·25 in. diameter





Lidkoping centreless grinding machine for bars up to 4 in. diameter

and machined bar from the melting plant at Witton, normally 5 in. square or 6 in. round.

The process is essentially one of preheating and hot rolling rod in closed passes to finished size. In general, a sequence of square passes, followed by alternate squares and ovals, is used, the final round section being derived from an oval of suitable size. After rolling, the rod is cut to length and for most applications centreless ground, centreless turned or lathe turned, followed by etching in hydrofluoric/nitric acid mixture, and final inspection.

The essential requirements of the rolling equipment are speed and accuracy. Speed is necessary because titanium, owing to its low heat content, cools very quickly; accuracy is essential to ensure the highest possible yield.

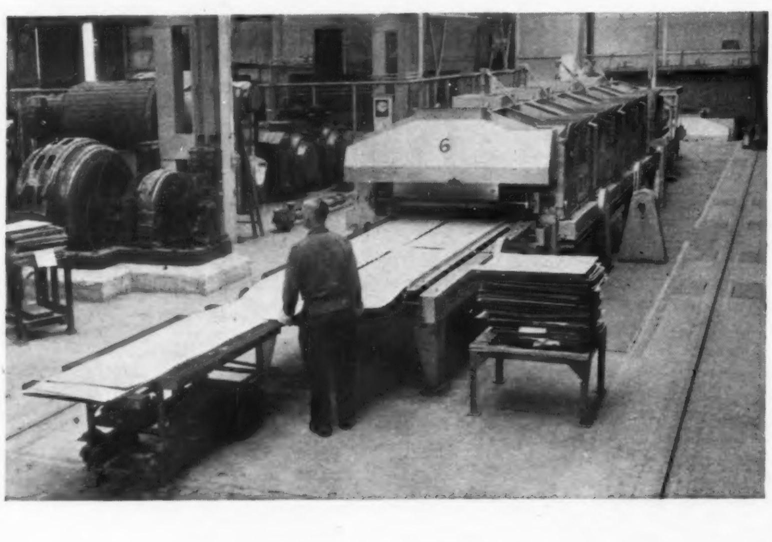
The rolling equipment includes a Robertson 2-stand 3-high mill used for breaking down bar stock and for finishing large diameter rounds by hand rolling. The mill is fed by two Birlec walking-beam electric preheating furnaces, each capable of preheating billets up to 6 in. diameter by 6 ft. long.

Stock from the Robertson mill is fed to a Morgardshammer 5-stand guide mill for finishing rounds from about 2 in. to 0·25 in. diameter. This mill is of unique design in that the stands, which are detachable for roll changing and setting up, consist essentially only of short rolls in roller-bearing chocks held together by very rigid screws. In this equipment, deflection of the rolls during rolling is extremely small, and rod of very accurate dimensions can be produced. The mill was selected for the titanium plant mainly because of the yield improvements made possible by increased dimensional accuracy. It is fitted throughout with roller guides and is normally operated with repeaters. The exit speed from the fifth stand may be up to 1,500 ft/min. A small electric furnace is sited on the entry side of the mill for reheating small diameter rod stock.

On the outgoing side of the Morgardshammer mill, and fed from the mill by roller conveyors, are cut-off shears and two Bronx reeling machines, which cover between them a range from 0·5 in. to 3 in. diameter. There is also a Loewy coiler for coiling the smaller diameter stock. Ancillary equipment in the bay includes abrasive cut-off machines and two gag presses used for the straightening of heavy bar and sections.

The finishing bay houses four centreless grinding machines, including a Lidkoping machine with powered tables, capable of grinding bars up to 4 in. diameter, a centreless turning machine, a bar lathe, cut-off machines and inspection equipment. An electric furnace with facilities for rapid quenching is available for the heat-treatment of alloy rod.

G.W.B. continuous annealing furnace capable of operating at 1,000°C.



Sheet Plant

In the sheet plant, products comprise a range of cold rolled sheet in Titanium 120, 130 and 160, in 2 ft. and 3 ft. widths, with the possibility of development of widths up to 4ft. The thinnest material at present produced is 2 ft × 0·008 in. in Titanium 120 and 130.

Hot rolled alloy sheet (Titanium 317 and 318A) is at present supplied in widths up to 3 ft. and thicknesses down to about 0·024 in.

The capacity of the plant depends on the type and gauge of product, but is of the order of 300 tons/annum of commercially pure titanium or, alternatively, 150 tons/annum of commercially pure metal and 50 tons of alloy sheet.

Base material for the plant consists of strip produced at Witton by hot rolling forged and machined slab.

General view of sheet finishing bay

For commercially pure sheet, the process consists essentially of descaling and dressing the hot rolled blank, followed by a series of cold rolling and annealing operations, with some intermediate descaling and dressing operations, to final gauge, at which the sheet is annealed, descaled, pickled and sheared to size. Alloy sheet requires hot rolling to finished gauge, with intermediate descaling and dressing.

The rolling equipment in the heavy bay consists of a series of three rolling mills:—

(1) A Brightside 3-high mill with rolls of 68 in. barrel length. This unit is used for intermediate breaking down of the hot rolled strip prior to finishing on 4-high mills.

(2) A Robertson 4-high mill, also with 68 in. wide rolls, used for cold rolling commercially pure sheet to gauges down to about 0·008 in. This mill is extremely powerful and, as a result of modification, is capable of rolling at pressures of up to 45 tons per in. width of material; this is one of the highest specific rolling loads employed in this country. It can be fitted with either 16½ in. or 14½ in. diameter rolls.

(3) A Sack 4-high mill with 60 in. rolls, used for alloy sheet hot rolling. This is equipped with two electric preheating furnaces, each with two heating chambers. The mill enables the very heavy loads necessary for hot rolling alloys to be applied.

All process and final annealing of commercially pure and alloy sheet is carried out in a G.W.B. roller hearth continuous electric furnace capable of operating at up to 1,000°C. This method of annealing ensures that sheets remain flat during the process, and also that the layer of oxide scale is uniform and hence more easily removed.

One end of the light bay is equipped for the receipt of material from Witton, and for cutting hot rolled strip to blank lengths. The bay also houses benches for sheet dressing, which is carried out by hand or machine scraping, roller levelling and stretching machines, guillotine shears and final inspection benches.

A descaling plant is contained in an enclosed lean-to bay. Commercially pure sheet is descaled by acid pickling, which is preceded in some instances by pretreatment in a special scale-modification bath.

Mechanical methods are normally used for descaling alloy sheet.

The Armco-Sendzimir galvanizing line designed and installed by The Head Wrightson Machine Co. Ltd., at Richard Thomas and Baldwins Ltd., Ebbw Vale. Described in "Metal Industry", 2 May, 1958, page 355, it has long looping sections to allow a continuous strip speed of 250 ft/min through the furnace. The length of strip in the line at one time is about 2,000 ft.

Finishing Supplement

Institute of Metal Finishing

PROCEEDINGS AT ANNUAL CONFERENCE AT TORQUAY

(Continued from METAL INDUSTRY, 30 May 1958)

AT the second technical session of the Annual Conference of the Institute of Metal Finishing, which was held recently at Torquay, **Mr. R. A. F. Hammond** (Ministry of Supply) occupied the chair, and the following Papers were presented for discussion: "Bright Nickel and Levelling Power," by E. Bertorelle, I. R. Bellobono and C. Bordonall; "Stress in Nickel Electrodeposits," by T. P. Hoar and D. J. Arrowsmith; "Surface Preparation and Porosity in Electrodeposited Nickel," by P. A. Brook.

In the absence of the authors, the first of these Papers was not extensively discussed, but abstracts of the other two are published here, together with the more important contributions to the discussion.

Stress in Nickel Electrodeposits

By T. P. HOAR and D. J. ARROWSMITH

STRESS developed in nickel electrodeposits from the earliest stages up to the stage of steady production of stress has been continuously measured, for a plain Watts bath and for baths containing typical stress-reducing agents.

Tensile stress developed in deposits from the plain Watts bath is reduced and finally made compressive in a continuous manner as the concentration of stress-reducing agent is increased. The "instantaneous stress" (the stress in any small increment of thickness) becomes nearly constant with thickness; it is not markedly influenced by the temperature or current-density of deposition.

The results are interpreted by means of vacant-site and dislocation theory. Tensile stress appears to result from the formation of an oriented array of edge dislocations initiated by surface vacant sites, the overcrowded side of each dislocation being the side remote from the growing surface. Compressive stress results from stress-reducing molecules being adsorbed at surface vacant sites and so initiating edge dislocations of the reverse orientation. The ratio of the concentrations of the two types of dislocation then determines the magnitude and sign of the stress, which thus changes continuously with the degree of adsorption.

(*Trans. Inst. Met. Finishing*, 1958-59, **36**, *Advance Copy No.* 5)

Surface Preparation and Porosity in Electrodeposited Nickel

By P. A. BROOK

UNTIL recently the available methods for measuring porosity were destructive, but radioactive isotopes provide a new approach based on radiographic methods, and their use in the determination of porosity has already given promising results.

The prepared copper basis was first plated with a layer of radioactive nickel and then with a layer of non-active nickel under identical conditions. The prepared specimens were left in close contact with a photographic plate for some days, when the plate was developed to show the pores. The plate was darkened to a greater extent where the radioactivity had penetrated the pores.

The average number of pores/in^2 for each surface preparation was between 12 and 15, with the exception of those prepared by method 3 which have the much higher average of 22. In view of this result, two further sets of specimens were made, using exactly the same technique but with scrupulous attention given to the washing after scouring. The average number of pores for these sets was found to be 13 and 14 per in^2. The result of this experience emphasizes the need for removal of all non-conducting material from the surface of the work to be plated.

The number of pores on the specimens varies between 8 and 27, and statistical analysis indicates that the porosity induced by the nature of the surface layer is only affected by changes in the gross characteristics of the surface, and that methods of surface preparation employed in this work do not influence the porosity in a deposit of the thickness used.

(*Trans. Inst. Met. Finishing*, 1958, **35**, *Advance Copy No.* 6)

DISCUSSION

Dr. J. Edwards (Head, Electrodeposition Section, British Non-Ferrous Metals Research Association):

Although the theory is very attractive, it is clear that Dr. Hoar does not regard the relatively few data so far produced as in any way established. One requires to know more about the incorporation of substances and the factors controlling the development of stress in the absence of organic addition agents.

Very often it happens in our work that the stress is reduced with increasing concentration of addition agents, rather as Dr. Hoar says. The stress may come down across zero stress without showing any discontinuity, and then in some cases, if the concentration is increased further, it simply attains a constant value. In other cases, however, it begins to rise again and may reach quite high tensile values. In yet other cases, it may come further and come down again, although this is probably due to cracking causing stress relief.

Yet another instance is provided by substances which, starting at the same stress, simply increase the stress continuously without increasing the concentration, again with a possible turn down when very high stresses are reached, possibly due to cracking. Many of the substances added to nickel baths to promote levelling or brightening, reduce stress, at least in relatively low concentration, not usually those substances referred to as stress reducers or anti-stress agents, partly because they may increase stress at higher concentrations but mainly, and rather illogically, because accompanying the decrease in stress there is a decrease in ductility.

A number of the substances falling in one category or the other are accompanied by an increase in ductility. However, materials with the lower stress in bright nickel baths often given increased ductility, or at least have no immediate effect on ductility.

It is interesting that substances of that kind — saccharin is the best known example—have no appreciable effect on cathode potential, and as far as our evidence goes, though it is not conclusive, they appear not to be incorporated in the deposit.

Dr. Hoar attempts a tentative explanation of compressive stresses in zinc and cadmium deposits from solutions not containing organic additions. He says it is conceivable that the compressive stress in zinc arises through the co-deposition of very small entities of the oxide or hydroxide that are able to create "inverted" edge dislocations. Would he be prepared to allot any role whatever

to basic material known to be incorporated in nickel deposits?

Brook's Paper is a welcome sign of the further application of radioactive isotopes to the study of electrodeposition problems. Precisely what kind of discontinuity is he looking for? What size of discontinuity does he think his technique is capable of detecting?

The beginning of his introduction to this Paper seems rather misleading. In most cases a considerable amount of nickel is corroded before extensive attack on the basis metal occurs There are a few pictures in Dr. Knapp's Paper, and everyone has seen how a nickel deposit fails very often by pitting which need not penetrate the deposit. When it does, extensive attack of the basis metal occurs underneath, and this is usually the case in a reasonably thick nickel/chromium deposit on top of steel or another basis metal that has been exposed to the atmosphere.

It may be that this does occur at points of weakness in the nickel or the chromium; but even if the weakness takes the form of a pore in the nickel, it is clear the pore has had only to permit corrosive liquids to penetrate to the basis metal without attacking the nickel.

It seems likely that such pores, if they exist, would not be detected by the radiographic technique. On the other hand, there are what have been called gross pores, fairly large holes in the deposit caused by solution or basis metal irregularities, bad preparation sometimes associated with pits or undulations torn out of the coating during polishing. This could lead to rapid attack of the basis metal and would be detected by Brook's technique. But it would be rather surprising to find in a deposit 0·001 in. thick, ten or fifteen or more such pores per in^2. Perhaps Brook will be able to make some calculation of the size of discontinuity which he would expect to detect.

In one of the Papers he refers to, it is calculated that the smallest pore that could be detected was about 0·001 in. across. That is rather a large hole in a deposit which is only about 0·001 in. thick. They used a different technique and irradiated from behind through the basis metal and the deposit, and Brook's technique may be more sensitive.

H. D. Hughes (Metachemical Process): Dr. Hoar's Paper states simply that deposits were made on to shim steel, and does not define the condition of that steel in relation to grain size or orientation. Our work has been of a practical nature, concerned with the production of thick layers of nickel up to from 0·010 in. to 0·015 in. of electroform nickel, with the desired properties of high hardness and a combination of resistance to deformation and to cracking under high impact load. None of the deposits giving hardness values of the order required, using solutions containing addition agents, would withstand the impact loads, and attention was directed to another possible method using the influence of the basis material grain size.

Steels taken from the middle of the standard grain size have an average approximate diameter of 0·003 in. Consequently, a conducting material with effective grain size of less than one micron was prepared. This was done by processing finely divided graphite with a preferred orientation.

Using a standard Watts nickel solution operating at 35°C. and an average current density of 15 amp/ft^2, the following comparisons were obtained. The hardness of the nickel deposit compares at 480 to 520 V.P.N., on the fine base, with 120 to 160 on to the stainless steel of normal grain size. Tensile strength is in the same order and elongation is in reverse proportion. The structure of the material cannot be examined by photo-micrography but after crystallization at 1,000°C. throughout the deposit there shows a steady growth from an extremely fine base up to a large grain size. This is quite regular and agrees partially with microhardness tests across the section, which show a slight but definite loss in hardness occurring with increasing thickness.

More important for purposes of the discussion of this Paper is that the fine grain nickel is always in compressive stress, whilst nickel deposited on steel is in tensile stress, deposited in exactly the same time and the same bath, in the same conditions.

D. D. Jones (Metallurgy Department, University of Swansea):

Brook refers to the ferricyanide reagent used in the ferroxyl test which has been found to attack nickel. Thorne and Addison have recently reported unpublished work in which nickel foil has remained unaffected for days in pure ferricyanide. Similarly, pure sodium chloride had no effect on the nickel. Attack set in with combinations of these two substances.

Reference is also made to the technique using either an external source of radioactivity or an X-ray generator as a source of emanation. This was tried, but the results were not satisfactory. The author could, perhaps, suggest an explanation as to why the results were not satisfactory. Is it because the maximum thickness of the basis metal to give satisfactory radiographs must be less than 0·003 in?

One advantage of the technique used in an external source is that it does away with the intermediate layer of radioactive metal which could affect the porosity of the finer non-active coating. Also, in the actual technique there is an interruption of the plating between the non-active and radioactive parts. This might be very small, but it could have an effect on the porosity of the subsequent layer.

What do the radiographs show? Brooks says there are two types. One gives the mechanical imperfections on the plate. How do these arise? Are they not mechanical imperfections on the photographic plate? Then there is the actual interpretation of these diffuse spots. They would seem to be difficult to interpret, as Wolff has stated that the primary disadvantage of the method seems to lie in the subjective examination, which depends on the skill of the examiner. It has elsewhere been suggested that discontinuities on the coatings may be pores, dead end or massed pits, voids, inclusions or gas pits. There is some possibility of identifying the type of discontinuity, but Ogburn and Hilkert do not go into this.

The author concludes that, for the methods employed, surface preparation has no effect on the porosity of electrodeposited nickel. In the section headed "Conclusion," however, he says that methods of surface preparation employed in this work do not influence the porosity in a deposit of the thickness used. In work by the late A. N. Hothersall and Hammond, the thickness of the nickel used was one-twentieth to one-fifth of the thickness used by the author of this Paper. Evans and Shone used a thickness of 0·00004 in. Therefore, the effect of surface roughness on porosity would be greater at smaller thicknesses. Is the author carrying out experiments on the effect of varying the thickness of non-active nickel on the number of radiographic spots, keeping the thickness of the layer constant, or would the results conform to the well-known hyperbolic graph of porosity versus thickness?

(To be continued)

Determination of Zinc and Cadmium

By R. A. BAKER

USES of E.D.T.A. solutions for analysis of zinc and cadmium have been known for some time but their adoption by the plating chemist for general control analysis is by no means universal. This is rather difficult to understand when it is appreciated that the method offers a considerable reduction in the time taken for estimation combined with extreme simplicity and no loss of accuracy. The usual technique for the analysis of these constituents is either by electrolysis, which tends to give slightly low results in the case of zinc due to difficulty in the deposition of last traces of metallic zinc, or by fuming to destroy cyanide, removal of iron and titration with potassium ferrocyanide. These methods can be compared with the following suggested technique using E.D.T.A. for both cadmium and zinc.

Pipette a 2 mL. sample into a titration beaker and add 100 mL. distilled water. Add 25 per cent hydrochloric acid drop-wise until a slight cloud forms. Add 10 mL. 0·880 ammonia (NH_4OH). Add sufficient indicator powder to produce a deep colour (only a few grains are required). Add 10 mL. formaldehyde reagent (1 mL. formaldehyde 9 mL. water). Titrate with E.D.T.A. solution until colour changes from red to blue. The end point is extremely sharp, provided that the titration is carried out immediately after adding the formaldehyde reagent.

The accuracy of this method has been compared with other standard methods of analysis carried out on previously prepared solutions containing known concentrations of zinc or cadmium

TABLE I—ZINC ESTIMATION

Amount of zinc known to be present gm/L	Analysis by E. D. T. A. gm/L	Analysis by electrolysis gm/L	Analysis by fuming and subsequent titration with potassium ferrocyanide gm/L
30	29·8	28·53	29·67
15	15·2	14·8	15·4
45	45·05	44·85	45·2

TABLE II—CADMIUM ESTIMATION

Amount of cadmium known to be present gm/L	Analysis by E. D. T. A. gm/L	Analysis by electrolysis gm/L	Analysis by precipitation of sulphide and subsequent titration gm/L
20	19·95	20·02	19·72
35	35·00	34·98	34·80
30	49·90	49·92	48·85

TABLE III—ZINC IN BRASS SOLUTIONS

Amount of zinc present gm/L	Analysis by E. D. T. A. gm/L	Zinc by difference after electrolysis of copper and zinc gm/L	Zinc after precipitation as sulphide and subsequent titration gm/L
8	8·05	7·75	7·68
15	14·93	14·80	14·82
25	25·2	24·80	24·33

added as "Analar" salt. The solutions were also prepared so as to contain the amounts of sodium cyanide, sodium hydroxide, and sodium carbonate normally found in plating solution.

From Tables I, II and III it appears that the E.D.T.A. method compares favourably with existing methods, and although it is by no means suggested that speed is an over important factor in analysis, the ability to supply analysis figures quickly is often appreciated by chemists closely concerned with maintenance of production.

In view of this fact the comparative times shown in Table IV may be of interest.

TABLE IV—TIMES COMPARED

By E.D.T.A.	By electrolysis	By fuming and titration
5 min.	120 min.	95 min.

Reagents

The indicator mixture is prepared by mixing 1 gm. of Erichrome Black Indicator with 100 gm. of pure dry sodium chloride.

The strength of the E.D.T.A. solution should be such that a convenient titration may be obtained over the range of metallic concentrations in the solutions to be analysed. A suggested concentration would be 21·5 gm/L. of pure E.D.T.A. (diamino-ethane-tetra-acetic acid-disodium salt). Such a solution should be standardized against a known strength zinc solution prepared by dissolving pure metallic zinc in dilute hydrochloric acid. From the standardization titration a factor may be evaluated for 1 mL. of E.D.T.A. solution equivalent to grammes metallic zinc or cadmium.

If the solution is made up to *exactly* the above suggested strength the following factors are obtained.

1 mL. E.D.T.A. solution
=0·003125 gm. zinc

1 mL. E.D.T.A. solution
=0·005375 gm. cadmium

The factor obtained by standardizing against zinc when multiplied by 1·72 gives equivalent factor for cadmium.

Men and Metals

At the annual general meeting of the National Association of Non-Ferrous Scrap Metal Merchants, held in London on Wednesday last, **Mr. R. O. Barnett** was elected President for the ensuing year. Mr. Barnett is a director of the Birmingham firm of Arthur E. Milner (Metals) Ltd.

We are informed that **Mr. H. W. Boyne** has now joined Colloidal Graphite Limited, as technical sales representative. Until recently Mr. Boyne was home sales manager of Arthur Balfour and Company Limited.

An announcement from The British Aluminium Company Limited is to the effect that **Mr. J. J. Boex**, Controller of Associated Interests, has been appointed a director of the company.

It has been announced by the Department of Scientific and Industrial Research that **Vice-Admiral Sir Frank Mason,** K.C.B., M.I.Mech.E., M.I.Mar.E., has been appointed to succeed **Sir Andrew McCance,** F.R.S., as chairman of the Mechanical Engineering Research Board.

Research chemist with Croda Limited, of Snaith, Goole, Yorks., **Mr. Alwyn Readshaw** has been appointed to lead the production team at the new Croda Belge factory at Verviers. Mr. Readshaw, who is 21 and began his career with Croda straight from school, will take up his new appointment next month.

Although retiring as managing director of Chemical Construction (Great Britain) Limited, **Mr. M. S. Henderson** is to continue as a director of the company for the present. The newly-appointed managing director is **Dr. R. H. Dodd,** Ph.D., who was born in the United States and educated at the Massachusetts Institute of Technology and the University of Wisconsin. Dr. Dodd has held many important professional and industrial appointments in the United States, including that of Professor and Head of the School of Chemical Engineering at Oklahoma State University. He holds membership in several American professional societies, as well as being a member of the Institution of Chemical Engineers, the Society of Chemical Industry, and a Fellow of the Institute of Petroleum.

INFORMAL DISCUSSION ON PRACTICE OF COMPACTING AND SINTERING

Developments in Powder Metallurgy

(Continued from METAL INDUSTRY, 6 June, 1958)

FURTHER extracts are published here from the discussion which was organized by the Powder Metallurgy Joint Group of the Iron and Steel Institute and the Institute of Metals. A number of points that had been raised in the early part of the meeting, and the replies by the authors, were published last week, and these extracts contain further questions from delegates and authors' replies.

DISCUSSION

Dr. J. F. Watkinson (B.S.A. Research Group):

Worn mentioned that to improve the viscosity in the gas they had changed from air to hydrogen. Another effect is consequent upon this: they have replaced an oxidizing medium by a protective gas. It is possible the rolling and sintering operations might be combined by heating through the rolls. Has Worn any experience of that?

The powders used in general for the direct rolling process should have an irregular shape and a low apparent density. At the same time, flowability considerations enter into it, and those conditions are such that they do not favour flowability. Does that mean that in practice it is necessary to arrive at a compromise between these two considerations, on the one hand flowability and on the other the ideal particle shape from the point of view of compaction?

Worn mentions the short sintering times used in making strip from pure metal powders, nickel and copper. Other materials, of course, are produced in strip form by the direct rolling process, quite highly alloyed materials, which are in general produced today from the different constituent alloy powders. Presumably these short sinter times do not give a completely homogeneous alloy. Does this mean that subsequent sintering operations must be used to achieve homogeneity in the alloy material?

Penrice showed some turbine blade shapes which had been produced by the Vinamold technique. Did these external shapes result directly from pressing and subsequently sintering, or in fact have the parts been produced oversize and the external surface machined prior to sintering?

The advantage in producing a complicated shape by hydrostatic pressing is in overcoming the distortion trouble which is experienced with the conventional pressing technique. For instance, with an ordinary square block with conventional pressing, a lower density region occurs in the middle of the block, and on sintering instead of getting the square shape a block with a waist in the centre is produced. Penrice suggested that in bringing this process to a production method the shape should first of all be produced by a conventional pressing technique and then the uneven pressure distribution overcome by subsequently pressing in the Vinamold and then sintering; but then this stage, instead of taking place during sintering, will be transferred to the intermediate pressing stage in the Vinamold, and this difficulty will still have to be met.

In normal hydrostatic pressing at say, 50 tons/in^2, instead of using simple cylinders with top and bottom plunger it is found that the stresses set up in the die material are such that a complex arrangement must be adopted in which the wall may be formed of three or four components shrunk on to each other so as to reduce (i) the hazard of breakage and (ii) the expansion which can take place during compaction opening up the gap to such an extent that sealing arrangements cannot adequately take care of it. Is this problem still present when using Vinamold and working at 50 tons/in^2? Is it still necessary to use these complex die arrangements?

M. Honey (Apex Construction Ltd.):

In the Vinamold technique the powder is being moved not only in the up and down directions but in the two sideways directions, and from this idea of pressure distribution it seems that it would be very good if it was possible to press long bars, because at the end of a bar one would be reducing the volume by a certain amount top and bottom, and theoretically, if one thought that the powder was acting uniformly in straight lines one would hope for equal density and equal pressure in the final billet throughout its depth, but if one pressed sideways as well there must be a zone in the Vinamold process in the top right and bottom left corners which was also a high density zone and not influenced by die wall friction but by the fact that one was pressing the corner twice, from the top and the bottom. In such a bar what should the density distribution be. Does anyone know? The conclusion appears to be that the Vinamold technique should be used on long components but not on components of large diameter.

Mr. Greatrix (Sintered Products Ltd.):

It is emphasized in Worn's Paper that precise control of the feeding of the powder to the roll gap is essential if a product of good and regular quality is to be obtained, and it is stated that the powders used are often characterized by relatively poor flowing properties. It is obvious that free flowing properties would give rise to difficulties in the control of the actual compacting operation. Problems of uniform feeding, however, would seem to be involved, and in the case of fine powders susceptible to damping from moisture in the atmosphere some atmosphere control or drying of the powder before presentation to the rolls would seem to be necessary.

Dr. R. Edwards (Metro-Cutanit Ltd.):

Referring to Penrice's reply and to Shute's contribution, a ball is a very simple shape and can be reproduced again by using rubber. The Vinamold mould can be reproduced in rubber.

In reply to Penrice, with these long pieces there is a technique in hydrostatic pressing by which an outer rubber sheath can be packed with sand, and the then hydrostatic pressure can be applied from the outside and transmitted through the sand. There is a pseudo-solid on the outside which the sand reproduces. For re-pressing Vinamold has an advantage; it is not possible to re-press without expensive rubber moulds.

With regard to pumps, Penrice did mention that there are not many pumps available which would give the pressures to which one wants to go. Up to 10 tons/in^2 there are pumps available and comparatively cheap, so that one is not restricted to plunger-type pressing. If one wants to use a mould 10 in. in diameter it is necessary to have a press capable of giving 150 tons/in^2.

R. F. Smart (Tin Research Institute):

Has Worn any experience of rolling powders of metals which normally do not undergo sintering, in particular, tin? If tin is sintered after pressing there is no beneficial effect in properties, probably because the oxide films cannot be reduced in a normal sintering atmosphere such as hydrogen, carbon monoxide and so on. By the pure pressing of tin powder unsatisfactory compacts are produced, whereas by extrusion quite satisfactory products are obtained. The difference is probably due to the fact that in the former case there is relatively pure compression and in the latter a rubbing action superimposed which breaks down the outside film. Will direct rolling allow the films to be broken down completely and give a satisfactory product?

A comment has been made on sintering titanium powder. It has been our experience that titanium powder can be sintered adequately and that the products have good properties. Very fine powder has been used, which is perhaps surprising, but if it is pure enough and the pressure in the sintering apparatus is suitable good results can be obtained.

H. J. Hartley (Henry Wiggin and Co. Ltd.):

Penrice refers almost exclusively to the use of wax-impregnated powders in connection with his work. Is there any difficulty with stiction in the use of dry powders in that case? Dr. Edwards mentioned the use of high-pressure pumps. That might possibly mitigate the tensile effect to which Penrice referred in the case of long pressings. Does he think that that would be so? He referred to a two-piece or multiple-piece device, but not exactly to what may be called a split mould. Can a split mould be used?

In connection with the use of the direct rolling process for alloys, one speaker who referred to this forgot the tremendous accelerating effect on diffusion and sintering due to work, and repetitive work, where one cold works sintered material before the fusion is complete.

AUTHORS' REPLIES

D. K. Worn: Dr. Watkinson raised the question of the true effect of hydrogen in the roll gap. There may be some reduction even of oxides on the surface, but our feeling is that the effect observed is really due to the change in viscosity. The viscosity of the hydrogen is about 18 compared with 180. It is possible to show this effect of interference by trapped air by measuring the air pressure just above the gap. We know that there is interference there, and it seems logical to

suppose that by reducing the viscosity of the gas this effect is produced.

He also asked about the possibility of heating the rolls. In the patent literature there are several references to carrying out the operation hot, but the practical difficulties are great, as may be imagined. We have done no work in that direction, but in the U.S.A. in dealing with copper they incorporate a hot mill immediately after the sintering furnace and in effect they get in some hot work very quickly, but not during the initial compaction operation.

With regard to the powder properties of the material, it is helpful to consider the two extremes. At one extreme is an atomized powder with spherical particle shape, which has extremely good flowability. Especially when working with horizontally-arranged rolls, these powders run through the roll gap without being compacted at all. With limited experience of vertical roll arrangements it has been found that these spherical powders do not compact readily and tend to run through the roll gap. It is true that powder which has very poor flowing properties is preferred, so poor that it is not possible to use an ordinary ball flowmeter to measure them. We go by the angle of repose, and it looks as though a powder with an angle of repose of about 63 is needed, which is very high.

We are extremely interested in alloy production, and we are endeavouring at the moment to apply this technique to various nickel-iron magnetic alloys in particular, and also to cupro-nickels. One problem is to secure adequate homogeneity. It is true that with normal sintering treatments it is necessary to give prolonged treatments to attain that homogeneity. Even with the finest powders one may need 6 hr. at 1200°C. to get adequate homogeneity in 18-20 per cent nickel-iron, which is a sluggish alloy. Will someone be able to evolve an activated sintering technique which will allow a marked cut down in sintering time. Other alloys are easier; 50/50 cobalt-iron sinters in a very short time.

Greatrix mentioned flowability, and Smart referred to tin-containing materials and perhaps had in mind tin bronze. A good deal of work has been done on this subject in Germany by Krebs, who says that it is possible to get good properties by direct rolling.

T. W. Penrice (in reply): Clow referred earlier to the strength of the outer container, and this point has since been raised by Dr. Watkinson. Perhaps Clow had in mind comparing the strength of container necessary for the gel and for fluid, but there is no difference whatever fundamentally; it is a question of the size of the compact and the size of the working space that it is necessary to have and the pressure which one is going to use. The strength will be measured as a function of those, and experience shows, as would be expected, that pressures of 50 tons/in^2 are being used only with comparatively small components, and it is then simple to have a fairly hefty block of steel to contain those pressures. With larger sizes, more moderate pressures of 15 tons/in^2 and thereabouts are being used. This has not been a general problem with us. Die casings are usually employed with a reasonable elongation, so that failure can be by stretching of the die and allowing the material to escape past the plunger. That type of construction is preferred as affording a safety-valve.

This process has been used for some time, and some of our production people have been a little cheeky in what they have done with it. There was an example of carrying out this process in a conventional hardened steel die which had already seen many years of service. It was scored on the inside and had been used for a number of pressings at 50 tons/in^2, and it failed below 40 tons/in^2. It did not do any damage, but we reverted to our practice of using soft die steel casings. If that is done and a reasonable safety margin allowed, that point is well covered. The advisability of using shrunk rings on the outside has been considered, but in fact it was not found necessary to go so far.

One point which has not been mentioned so far is the method of sealing, which is normally a difficulty in the use of a rubber sheath in a fluid. It is at that point that a great deal of the distortion and malformation of the components result. One frequently finds steel plugs being used in the steel industry, and sometimes rubber to rubber, and any additional stiffness caused by the steel distorts the component considerably. From the original size of the compact the greater part of the shrinkage occurs at the lower pressure end of the scale, and at the higher pressure end there is not much additional movement. If the sheath has any particular stiffness in the top corner, the effect is to produce a type of pressing with very considerable wastage of material and frequent off-cuts on the length, due to this sealing. This effect is at a minimum when using Vinamold.

Dr. Watkinson asked whether or not the turbine blade shape shown on a slide had been machined. It had been. The point there is that in working with a core of that shape it was required to produce a turbine blade with a wall thickness of about 1 mm. It is easy to machine without using the core as a reference, so that we get the outer form and keep the constant wall thickness. It is much easier for us to have extra material and machine it back to shape, having done the difficult part of the work on the core, and so no attempt was made to incorporate the finished dimensions on the outside of that. In all these cases where we press direct from Vinamold with the powder a machining allowance is normally provided.

That relates to another point made by Watkinson, who said that pressing rectangular bar and then subjecting it to Vinamold pressing merely transfers the distortion from the sintered stage to the pressing stage. It does, and that is the whole essence of it. The rectangular bar is not a very exciting shape and there is not very much call for such bars, but much more complex shapes are cut out of those bars, and it is there that this process is found of particular value. If a rectangular bar is to be made into a turbine blade shape and the blade form produced by machining, the leading edge of the blade may be in a zone pressed at high pressure and the trailing edge from a zone with an appreciably different pressure applied to it. When that is sintered, the contraction rate on the trailing edge will be much higher than that on the leading edge, and the blade will twist. That danger can be eliminated by the use of the additional stage of hydrostatic pressing.

Reference was made by another speaker to the pressure distribution in the compact. The pressure distribution he mentioned would be unlikely to apply when using Vinamold, because this has been due largely to the friction effect on the die wall. The area in the corner will be the area most effectively compressed, because it is the area with the least distance from the surface at the two directions at right angles. The point was made, when dealing with the 5-in.-long bar, that the powder had moved in the new direction of pressing. Not so much of that would occur in the true Vinamold pressing. In practice it is considerably better than anything tried before, and we let it go at that.

Dr. Edwards raised the question of rubber for balls. Rubber does not deform so readily in the conditions in which we have been able to get it, and the range of working is restricted by the fact that when we have sufficient deformation present tearing of the rubber occurs, and not by this idea of a semi-permanent mould.

The question was raised of our use exclusively of wax-impregnated powders. This process has been used for dry powders. It is not part of our normal production to do that, but it works equally well with dry powders. One reaches the limit of the length/diameter ratio a little earlier, because in general the compacts with dry powders have lower strength. With regard to the suggestion of using a split mould rather than a two-piece mould, the only point there is that it is necessary to get the powder in, and it must be put in very gently and carefully, because it maintains the shape in which it is put into the mould. The device showing the making of the ball was the only way that could be seen of getting the powder in. With a horizontal split in the die, it would be possible to fill the powder only into the bottom half of the die.

(*To be continued*)

Obituary

Mr. V. Delport

WE deeply regret to record the death of Mr. Vincent Delport, one of this year's recipients of the Meritorious Services Medal of the Institute of British Foundrymen. Vincent Delport was director and treasurer of the Penton Publishing Co. Ltd., London, and was well known among foundrymen in Europe and America.

Among the many marks of recognition he received for his services to the foundry industry was a "citation award" from the American Foundrymen's Society, and an honorary membership of the Association Technique de Fonderie. He was a past-president of the International Committee of Foundry Technical Associations, on which he was the European delegate of the American Foundrymen's Society, a member of the General Council and a past-president of the London branch of the Institute of British Foundrymen. From 1941 to 1946, he was secretary of the Council of Ironfoundry Associations.

Mr. G. A. S. Harvey

WE also regret to record the death of Mr. George Alfred Sydney Harvey, President of G. A. Harvey and Company (London) Ltd. He entered his father's business at Lewisham and West Greenwich at 17, and was appointed chairman and managing director in 1937, and President in 1956.

Chemical and Petroleum Engineering

A NEW exhibition will present itself to the industrial world on Wednesday next (June 18) when the **Chemical and Petroleum Engineering Exhibition** will open at Olympia, London. This is the first exhibition of its kind in this country, and among the exhibits will be a number of new and improved products and techniques displayed for the first time. The exhibition remains open until June 28.

Space does not permit of a detailed description of all the exhibits, but we are able, through the courtesy of some of the exhibiting firms, to give a few details of the products which they will be showing.

Accles and Pollock Ltd. This Birmingham firm will be exhibiting examples of cold drawn seamless precision tubing in steel, stainless steel, and other metals; machined and honed bore tubes; jack bore tubes; manipulated and fabricated tubing; seamless flexible tubing and flexible joints; stainless thin-walled tubing; tubular special sections, and extended surface tubing. Also finned tubing in aluminium Magnox A12 and stainless steel, and tubular box spanners.

The A.P.V. Company Ltd. This company will be showing a recently-introduced plate evaporator which, by using plates instead of tubes, makes a simple and compact evaporator requiring only 8 ft. of head-room. There will also be shown the Paralloy range of "forging quality" cast stainless steel butt-welded flanges, elbows and tees, etc.

Babcock and Wilcox Ltd. By means of production units, models and photographic displays, this company will illustrate their experience, techniques and manufacturing facilities to meet the demands of the oil and chemical industries for complete steam-raising plants, pressure vessels (in a variety of materials), separately-fired superheaters, heat exchangers, and waste-heat utilization plant. Among exhibits of exceptional interest, mention may be made of two, being shown for the first time at this exhibition:—

A production unit of a floating-head type heat exchanger, as used in the power forming processes in the oil industry, demonstrates the wide range of facilities which the company have at their works in Renfrew and Oldbury for the fabrication by fusion welding of all types of pressure vessels.

An interesting display also shows the principle of operation and a typical installation of the CO boiler developed by the company to utilize efficiently, for steam-raising, both the sensible and combustible heat content of the exhaust gases from a catalytic cracking unit. These boilers are self-contained, and the CO gas ports of the boiler are supplemented by oil and refinery-gas burners for starting-up and auxiliary firing.

The comprehensive Babcock service and manufacturing facilities for oil-fired boiler plant is illustrated by models of the "FH" integral furnace boiler and the "Steambloc" packaged boiler, together with photographic panels of typical installations. In addition, examples and descriptive matter of the calorizing process will be shown, as well as examples of "Calmet," a chromium-nickel cast alloy, including several types of tube supports for service in boiler plant, superheaters, etc.

F. W. Berk and Co. Ltd. This firm is exhibiting for the first time their pilot plant spray dryer, which offers new designs for spray unit, air flow and dried product recovery. The Berk fluid bed dryer, recently introduced, will also be demonstrated.

Birkett, Billington and Newton Ltd. Among the main displays made by this Staffordshire firm will be a cold evaporator vessel in manganese bronze, finished weight approximately 1 ton, 14 cwt., test pressure 600 lb/in^2. Also channels and covers in aluminium bronze and high-duty iron; manganese bronze tube plate—with 11,000 drilled holes, weight 12 cwt.; and non-ferrous castings and machined parts, chill cast phosphor bronze rod, cored and solid, and continuous cast phosphor bronze rod, cored and solid.

Birlec Limited. Exhibits on this company's stand will represent the Birlec range of adsorption dryers and gas generating plant. A scale model will illustrate the arrangement of large neutral-gas generating plant, of new design, being shown for the first time. The plant operates from town's gas which, after controlled combustion, is stripped of undesired products, leaving nitrogen as virtually the only remaining constituent. The amine solution, used in the stripper, where CO_2 and H_2S are removed, is continuously reconcentrated, using waste heat from the combustion chamber to good advantage.

Other Birlec gas plants produce reducing or carburizing atmospheres. Coal gas, petroleum gases, and ammonia, are possible sources, according to the product-gas required and the respective costs. Examples of the Birlec dryers to be shown include a BA50, suitable for drying gases at 1,250 s.c.f.h. to an outlet dewpoint of $-60°$C.; a BX50 automatic dryer for compressed air at 150 lb/in^2/gauge; and a high pressure G 2-5 cartridge-type dryer for air at 6,250 lb/in^2/gauge. In addition, a small laboratory will be included which uses molecular sieves as the adsorbent, and which is thus capable of reaching extremely low dewpoints.

Birmingham Battery and Metal Co. Ltd. This company is exhibiting a comprehensive range of tubes and plates in copper and copper-based alloys. Prominent on their stand will be "Batalbra" (aluminium brass) tubes and sheets; "Batnickon" (copper-nickel-iron) tubes and sheets; "Baturnal" (brass screwing tubes, "Batnaval" (naval brass plates); "Battery" bimetal tubes, and "Dona" welding copper.

In addition, a range of hot brass stampings, such as impellers, etc., of special interest to the chemical and petroleum industries will be displayed by **Guests Brass Stamping Company,** an important subsidiary undertaking.

B.K.L. Alloys Ltd. This Birmingham firm is featuring products from both their engineering and magnesium departments. In the latter section will be shown anodes for the cathodic protection of metal structures, used to protect pipelines, piers, tankers, and other steel structures, which are in contact with soil or sea water, against electrolytic corrosion. Anodes made of very high purity zinc will also be shown.

From the engineering department will be shown mild and alloy steel welding fittings, as well as fittings in aluminium and Monel metal. A new product, aluminium pipe coupling, recently taken up by the company, will also be displayed. These couplings are intended for surface lines of aluminium pipe, and allow very speedy linking up of such pipes.

British Acheson Electrodes Ltd. The exhibits on this stand are arranged principally as two items of chemical plant. The main display will be a structure rising to the 20 ft. maximum height afforded by the available headroom, carrying an assembly of a complete plant for the production from hydrogen and chlorine of a pure form of anhydrous hydrogen chloride gas, such as is used in the manufacture of chlorinated plastics, e.g. PVC, etc. It is assumed that these gases are produced from the electrolysis of sodium chloride brine solutions. An "Acheson" graphite combustion chamber with a "Karbate" impervious graphite burner is used for burning chlorine in hydrogen to produce HCl gas. The product, which then contains additionally nitrogen, hydrogen and carbon dioxide gases, is then fed to a "Karbate" Standard Model 8 A falling film absorber. This item consists essentially of two parts, an 8-tube heat exchanger for absorption and removal of the heat of solution and a backing tower or tail gas scrubber.

The second, and smaller, feature of the stand shows a standard 2 in. size Model CC—18.A "Karbate" sectional cascade cooler to which has been fitted a mixing unit. This equipment is typical of a large number of units which are now operating for sulphuric acid dilution and after-cooling.

The display emphasizes the ease with which standard components can be used to construct process plant without alteration in many cases, and in others with only slight modifications. In addition to the above principal features, the firm is showing various "Karbate" parts, such as tube sheets for tube and shell heat exchangers, valves, steam jets, etc.

The British Aluminium Company Ltd. On this stand, applications of aluminium in the chemical industry are illustrated by a 4 ft. 6 in. diameter hot spun dished end for pressure vessel construction, and a new form of air-cooled heat exchanger, shown for the first time. The petrochemical industry is represented by a section of a bubble-cap distillation column. The low temperature properties of aluminium are featured, with particular reference to the importation of liquid methane into the United Kingdom. An illustration of a liquid methane storage tank now under construction at Canvey Island will be surmounted by an animated line diagram indicating the production, transport and end uses of the gas.

Tubing and structural sections are being exhibited with reference to oil pipe lines, oil derricks, and associated equipment.

Cast aluminium valves for use with high test hydrogen peroxide are also featured. The use of alumina in the petroleum industry is well established, and various grades of alumina will be shown.

British Insulated Callender's Cables Ltd. Here will be seen cabled copper tube, mineral-insulated cables and accessories, paper-insulated lead-covered mains cable, vulcanized rubber-insulated multicore cables, lead cover, and P.T.F.E. cables, rods and tubes.

British Oxygen Engineering Ltd. In association with its sales company, British Oxygen Linde Ltd., this firm will be providing examples of their range of services to the petroleum, chemical, gas, and steel industries. Prominence will be given to plant used for the supply of high-purity oxygen and nitrogen in tonnage form. Smaller plants, which have capacities of 100 ft^3 of gas per hr. and upwards, will also be illustrated. Other exhibits will demonstrate the company's additional activities, including the supply of complete plants for rare gas production, together with ancillary equipment such as pumps, compressors, vaporizers, mobile liquid oxygen tanks of 42 and 420 gal. capacity, and static liquid oxygen storage tanks in the one million ft^3 scale.

David Brown Companies. From this group of companies will be shown a 24 in. oil pipeline valve of a type which, it is understood, was manufactured only in the U.S.A. This valve is one of several sizes which are being made to the order of W.K.M. Valve Co. (Britain) Ltd., for use by the Shell Petroleum Co.

Copper Development Association. Copper is a traditional metal in the chemical engineering industry for a wide variety of applications, and the many special qualities of this metal and its numerous alloys are also of particular interest to petroleum engineers. The stand occupied by the C.D.A. will demonstrate the services provided by the association for advice and information on all matters appertaining to the use of copper and its alloys.

Items on the stand will include a typical application of copper sheet metal and pipe work in the form of a model gin still, whilst other items will demonstrate examples of pipe work, welding, brazing, and the like.

Elliott Brothers (London) Ltd. In a joint exhibit, this company, with its associate, Fisher Governor Co. Ltd., will be showing a wide range of equipment for the instrumentation and automatic control of processes in the chemical and petroleum industries. The exhibit will include displays of the latest electronic (Swartout Autronic) and pneumatic (Bristol's Metagraphic) indicating, recording and control instruments for continuous processes. These instruments will be shown in graphic panels representing typical oil refinery applications.

Another exhibit will be the dry-bellows differential pressure flowmeter of the Industrial Instrument Corporation of America, which is now manufactured and marketed in Europe by Elliott Brothers. Indicating, recording and transmitting versions of this very versatile instrument will be shown. The Fisher "Wizard" controller will also be shown and, exhibited for the first time (by the Fisher company) will be a blending unit for the in-line blending of intermediate grades of fuel oil. Other equipment to be displayed will include the Elliott Drimac force-balance differential pressure transmitter and the Bristol's Dynamaster fast response electronic potentiometer recorder. A full-scale model of a graphic control panel for a large oil tank farm, recently supplied to a customer, will also be shown.

Thos. Firth and John Brown Ltd. We understand that owing to the limitation of space, this Sheffield organization is confining its exhibits to steel in the form of rolled products, forgings and drop forgings, but the wider applications of their products will be illustrated by large coloured transparencies.

General Electric Co. Ltd. On this stand will be shown a typical installation of the G.E.C. pressurized system for feeding mains-operated electrical apparatus in situations where hydrogen (representing also town gas, coke oven gas, and blue water gas) is present. The system is intended to be applied to lighting installations or to any other type of equipment which is suitable for pressurization at $\frac{1}{4}$ lb/in^2. Exhibits of control gear will include a motor control centre as supplied for use in refineries. Also to be shown is an automatic flameproof gate-end panel for the control of squirrel cage motors at voltages from 400 V to 650 V, with full-load currents up to 80 amp. Other examples of the company's wide range of products will be shown.

G. A. Harvey and Co. (London) Ltd. Attention will be drawn by this firm to a vacuum pressure vessel, which is entirely of welded construction, weighing some 23 tons and made from mild steel plate $\frac{5}{8}$ in. thick and heavier. This exhibit will by no means represent the full scope of the firm's capacity in pressure vessel construction, but will serve to illustrate many of the features required in plant as used by the industries concerned in this exhibition. Techniques for both destructive and non-destructive inspection have been developed by the company, and a display of laboratory specimens, radiographs and micrographs will illustrate this aspect of heavy fabrication, and includes a section of a high-pressure vessel. The extensive range of "Harco" perforated metals and plastics will also be represented.

Head Wrightson Processes Ltd. Featured on this stand will be a model of the Dido reactor, and experts will be available to discuss the planning and installation of similar reactors in any part of the world.

Horwitch Smith and Co. Ltd. From this Staffordshire firm will come an exhibit which includes a comprehensive range of centrifugal and axial flow fans covering a wide variety of applications. There will also be examples of special-purpose fans. In the laboratory equipment section there will be displayed fume cupboards manufactured in PVC or polythene to standard or specific enquiries, while to meet the demands of the Clean Air Bill, certain parts of washing equipment, cyclones, and soot separators, have been developed and manufactured in rigid PVC to withstand the corrosive attack of the media to be cleansed.

In the field of fume extraction, many of this firm's installations have been included in plating and pickling processes. Other items exhibited include tank linings, pipes and pipe fittings, and a range of valves including special equipment such as proportioning valves, flow splitters and vacuum type.

Imperial Chemical Industries Limited, Metals Division. Prominently featured on this company's stand will be examples of the use of titanium in chemical plant. Because of its exceptional resistance to a wide variety of aggressive liquids and gases, I.C.I. titanium is now being used increasingly for complete components and as lining material. Products displayed will include large lined vessels and a variety of fabricated products such as valves and valve plates, gas nozzles, agitators, anodizing jigs, and complete exchange units. Examples of "Kynal" aluminium and aluminium alloy products will include fabricated pipework, vessels, heat exchangers, and wrought forms such as busbar, heat-transfer sheets, structural extrusions, profiled building sheets and treadplate.

Of particular interest to heat-exchange engineers will be the "Integron" finned tubing in steel, aluminium, and bi-metal, and "Tube-in-Strip," the company's latest heat-transfer material. There will also be shown wrought forms of new metals—zirconium, niobium and tantalum—developed for nuclear engineering but equally promising as materials for plant handling corrosive chemicals.

Bursting discs, "Marlite" flexible tanks and "Durestos" laminated plastics are being shown by **Marston Excelsior Limited.**

Johnson, Matthey and Co. Ltd. This exhibit will demonstrate the breadth of the company's services to the industries concerned and the importance of the noble metals in this field. Emphasis will be on the applications of platinum and its alloys. Among the exhibits will be the JMC platinum catalyst gauze nets, available in sizes up to 3 metres in diameter. Also, supported platinum and palladium catalysts on a variety of bases, including charcoal, silica gel, alumina and asbestos, will be displayed, as well as silver in crystalline and gauze forms as supplied for the production by catalysis of formaldehyde and other aldehydes.

Other exhibits on this stand will include platinum equipment for the glass industry; platinum sheathed anodes; thermocouples—among the combinations displayed being platinum:10 per cent rhodium-platinum, platinum:13 per cent rhodium-platinum, and 5 per cent rhodium-platinum:20 per cent rhodium-platinum for use up to 1,800°C. in intermittent readings and 1,500°C. continuously. The Pallador couple—40 per cent palladium-gold:10 per cent iridium-platinum—for use up to 650°C. will also be shown.

A wide selection of JMC certified bursting discs, holders and supports will be on show, and their functions illustrated by means of a high-speed film and a demonstration of the bursting of small discs. Among the numerous materials in which JMC bursting discs are supplied is Teflon-protected aluminium.

The stand will also include a number of examples of the use of silver for the protection of constructional materials employed in the chemical process industries—for instance, steel and copper. The excellent corrosion resistance of silver has for many years recommended its use as linings for reactors, condensers, evaporators, and other types of plant. A selection of

high-purity JMC chemical compounds, including compounds of the precious metals, compounds of minor and rarer metals, and rare earths will be displayed, together with Specpure spectrographically standardized substances and Matthey standards for analysis.

Langley Alloys Ltd. Amongst a wide range of valves, this company will be exhibiting the new DIN standard Y valve, produced in stainless steels.

The Mond Nickel Co. Ltd. The emphasis on this stand is on corrosion problems. The exhibits will be divided into six principal sections. The first two deal with wet and dry corrosion, and cover selection of materials, methods of testing, laboratory facilities, and examples of failures and successes.

The remaining four sections deal with metallic and saline catalysts, metal finishing, welding, and the mechanical properties of materials produced by the company. Apparatus illustrating the selection of suitable materials for specific applications, particularly in combating corrosion, will be displayed, and appropriate specimens of materials will be shown in each of the sections.

Northern Aluminium Co. Ltd. Pride of place on this company's stand is shared by two new developments that promise considerable benefits to both the petroleum and chemical industries. The first, aluminium oil piping, is shown in many sizes up to 10 in. diameter, together with couplings, welded joints, valves, and similar fittings. The second development on display is extra-wide aluminium plate, which is expected to broaden the scope of the designer of large aluminium fabrications such as are used extensively in chemical engineering. Aluminium plate is now being offered in sizes up to 11 ft. wide, and these are obtainable up to 30 ft. long.

The use of Noral plate for a large fabrication will be exemplified by a 6 ft. high unit manufactured by Fairey Aviation Co. Ltd., and also on show will be smaller fabrications for use in various fields. Special prominence is also to be given to a display of "Noralduct" roll-bonded heat-exchanger plates, with internal systems of ducts and cells of various thicknesses. In addition, finned heat-exchanger tubing and condenser tubing clad with a special aluminium alloy to provide maximum corrosion resistance are to be shown, as well as other uses for aluminium.

The Power-Gas Corporation Ltd. This company, in conjunction with other group members—Ashmore, Benson, Pease and Co., and Rose, Downs and Thompson Ltd.—will exhibit examples of their extensive range of equipment. The principal items displayed include a heat exchanger, 21 ft. in length, for use in a petroleum refinery, sample welds from a variety of metals, machined castings, and pressure-tested stainless steel pipework.

The Pyrene Company Ltd. Fire protection equipment is one of the main activities of this company, and various types of such equipment, particularly suitable for use in the oil industry, are displayed on this stand in the form of actual appliances, models and photographs. The number and size of "Pyrene" mechanical foam generators or foam-making branchpipes varies with the diameter of the tanks and the area to be protected; one oil tank with a diameter of 100 ft., for instance, would require four "No. 20" foam-making branchpipes, producing a foam output of 6,400 gal/min.

The latest portable foam unit for oil tank farms is the "Pyrene" telescopic foam tower, which is designed to provide automatic elevation by foam pressure and ensures the rapid application of foam to tank tops up to a height of 70 ft. It is made of light aluminium alloy and is transportable. Pouring heads of different types are available to suit the kind of discharge desired and the design of the tank to be protected. There are also available complete CO_2 installations for specific fire risks likely to be encountered in chemical works and oil refineries. In addition to manual operation, these installations are designed to incorporate fire detection systems and automatic operation where required.

Quasi-Arc Ltd. Electrodes and equipment used in the full range of arc welding processes will be exhibited on this stand. The new Lynx equipment for shielded inert gas metal arc welding on non-ferrous alloys, corrosion- and heat-resisting steels and mild steel, will also be demonstrated.

J. Stone and Company (Charlton) Ltd. Prominent in the post-war developments of this company has been a new series of copper alloys based on copper, manganese and aluminium. They are sold under the brand name of "Superston." The alloys have excellent casting characteristics and work properties, and the products made from them are characterized by high strength and great resistance to corrosion, erosion and corrosion fatigue. These alloys are also stated to be suitable for welding by Metalarc, Argonarc, and Argonaut processes.

The company's exhibit is devoted to Superston castings and wrought products such as have been supplied to the oil, chemical and marine industries. Castings for pumps and wrought products for heat exchangers are typical, and examples of welds will also be shown.

The Thermal Syndicate Ltd. This Northumberland firm is responsible for Vitreosil, pure fused quartz and silica, chemical plant for production of hydrochloric acid from chlorine and hydrogen, or by the salt-sulphuric acid process; distillation units for the production of pure hydrochloric, nitric and sulphuric acids, and also pure water; acid-proof, and also alkali-proof, electric immersion heaters for electroplating and pickling baths; buttress joints (to British Standard Specification) for pilot plant and pipelines. Also for Vitreosil industrial and laboratory ware, completely unaffected by all acids except hydrofluoric and phosphoric, for use up to 1,050°C., and special high-temperature refractory products in fused and recrystallized alumina, aluminous porcelain, fused magnesia, mullite, sillimanite, thoria, zircon and fused stabilized zirconia.

Westinghouse Brake and Signal Co. Ltd. The salient feature of this stand will be a water-cooled germanium rectifier assembly, part of a 3 megawatt installation for the generation of chlorine. The water circuit is electrically isolated from the rectifier circuit; thus the water, not contaminated, is suitable for other process purposes. Other displays will be photographs of rectifier installations; evidence of the wide applications of the company's equipment for A.C. to D.C. conversion, and of the experience they have gained in the associated control systems. Battery charger installations will show chargers for all types of battery-driven industrial trucks and delivery vehicles, starter batteries, and telephone exchange and sub-station float battery systems. Engine starters for petrol and diesel vehicles, cathodic protection rectifier systems for submerged and buried structures, and other rectifiers for the chemical and petroleum industries will be pictorially illustrated.

Henry Wiggin and Co. Ltd. The wide range of special alloys produced by this company includes materials resistant to corrosion and heat. Some of these: nickel, Monel and Inconel, have been standard materials for chemical plant construction for many years, and others—Corronel "B," Ni-o-nel, the Nimonic series and Incoloy—are more recent developments. Exhibits on this stand have been chosen to demonstrate not only the suitability of Wiggin nickel alloys for different types of service, but also that they are available in the forms required by plant constructors.

An example of the use of nickel-clad plate is to be seen in a section of a heat exchanger; a further example of the use of plate will be shown in a section of a distillation column fabricated in $\frac{3}{8}$ in. Monel plate. A section of a Glitsch tray will be shown as an example of the use of sheet material; a flame trap of Ni-o-nel will illustrate the type of construction calling for strip and tape, while an example of the use of extruded material will be provided by a hydrocarbon cracker tube made up from extruded Incoloy pipe.

A high-temperature catalyst container for an ammonia cracker, lent by Imperial Chemical Industries Limited, will provide an interesting example of fabrication of Inconel tubing, and the example of the use of forging will be provided by a Nimonic 75 pouring lip from a sodium silicate furnace, which has been in service in the works of Joseph Crossfield and Sons Ltd. A gear pump for handling sulphuric acid will give a good example of components machined from bar, the gears being of K. Monel. Examples of castings produced in Monel, including a sight-flow indicator and valve components, will also be shown.

Yorkshire Imperial Metals Ltd. Among the many interesting exhibits being shown by this company are solid drawn tubes for process heat exchangers, coolers, condensers, feed water heaters, fresh water evaporating plant, and other tubular heat exchange equipment in a wide range of special non-ferrous alloys to British Standard and A.S.T.M. specifications. Alloys include "Yorcalbro" and "Alumbro," 70:30 cupro-nickel and "Kunifer 30," "Yorcunie" and "Kunifer 10," "Yorkcunife" and "Kunifer 5" (copper-nickel-iron) and high tin bronzes, etc.

In addition, there will be shown heat exchanger end plates and baffle plates, etc., up to the largest sizes, in a wide range of alloys; Duplex (bi-metallic) tubes for various applications; small bore copper tubes (and applications of cabled copper tubing, as well as non-ferrous tubing in various alloys for applications in oil tankers—condensers, air and oil coolers, circulating and discharge pipes, calorifiers, fire mains, etc., and also tubes and fittings (capillary and compression types) for domestic and general engineering services.

Industrial News *Home and Overseas*

Wrought Titanium Prices

It was announced by **Imperial Chemical Industries Limited,** Metals Division, last week that a further substantial reduction was being made in the price of wrought titanium and titanium alloy products. For material delivered after July 1 next, rationalization of the price structure will result in reductions varying between 5 and 20 per cent, depending upon the form of wrought product and the grade or alloy of titanium used.

At present, I.C.I. wrought titanium sheet sells at about £6 a pound, and rod at about £5 a pound. Although, even with the reduction now announced, titanium is more costly than conventional structural metals, there are many instances where the unique properties of titanium may permit redesign of plant or equipment to reduce its size, and in this way such equipment in titanium would compare very favourably in price with equipment made from conventional materials.

It is clear, however, that maximum demand will only develop as prices are reduced, and I.C.I. policy has always been to bring down the selling price at the earliest possible moment. The present price changes follow the pattern forecast in February, 1957, when the selling price of I.C.I. wrought titanium products was reduced by an average 10 per cent.

New Factory at Redhill

Recently officially opened, the new factory for **Foxboro-Yoxall Ltd.** is built on a 58-acre site just to the north of Redhill, Surrey. It lies between the two railway lines which converge at Redhill, and just off the main London-Brighton road. The buildings at present comprise an office block, the factory, a power house, and a restaurant. All have been carefully sited and planned for subsequent expansion.

The office block covers 24,000 ft^2 and the factory 85,000 ft^2. The power house takes up 5,000 ft^2 and the restaurant 12,000 ft^2. The space to the north of the factory is being laid out as a sports field, making provision for football, cricket and tennis. A sports pavilion, which will be fully equipped with changing rooms, clubroom space, and kitchen and bar, is also included in the plan.

Non-Ferrous Club

At the monthly luncheon of **The Non-Ferrous Club,** held at the Queen's Hotel, Birmingham, last week, the guest speaker was Mr. W. McQuitty, a senior producer of the J. Arthur Rank Organization, who gave an interesting talk on the production difficulties in the film industry.

During the luncheon a collection was taken on behalf of the Empire Society for the Blind, resulting in a total of £15 1s. 0d. being donated.

Lead News

Issued by the **Lead Development Association,** the latest edition of Lead News contains illustrated articles on a wide variety of subjects, including three major developments of considerable significance to various industries. These are: an authoritative description of the recently-introduced method of smelting mixed lead and zinc charges by the "Improved Vertical Furnace" method; an article, at a popularly acceptable level, on the recent developments in this country in the production and usage of mechanically made homogeneous lead—principally for the chemical engineering industry; and an account of some recent developments in soldering, including the tinning and soldering of both cast iron and stainless.

Other topics covered include corrosion prevention, vibration and noise control, machining properties of leaded steels, and the usual list of technical publications.

Tin Production

World mine production of tin-in-concentrates fell in January to 12,900 long tons, compared with a December total of 16,200 tons, due to the control of exports, according to monthly statistics issued by the International Tin Council. During February, production fell again in Bolivia, Indonesia and Malaya; it remained in those three areas at much the same low level during March.

As for smelter production, world metal production during January was 14,900 tons, compared with 13,900 tons in December. During February, production fell in Malaya and the United Kingdom; during March it continued to fall in Malaya, but rose in the United Kingdom. Production in the Netherlands was low in the first three months of 1958.

Consumption during February fell slightly in the United Kingdom and in the United States, but in both countries it was above the December level. United Kingdom consumption in March remained on the same level as in February.

Coil Spring Research

Speaking at the annual conference at Torquay last week of the **Coil Spring Federation,** Mr. R. Salter Bache, President of the Federation, appealed for more members to support the industry's research organization. In the course of his remarks, Mr. Bache said that the importance of the development of materials, processes and techniques in spring production was not only a matter of interest to spring manufacturers, but also to all users of springs. He stressed the point that springs are frequently an essential but unnoticed component in a mechanism, yet their importance was often overlooked or taken for granted.

Dealing with the activities of the research organization, which last year was granted financial assistance by the Department of Scientific and Industrial Research for a further five years, Mr. Bache said that they were implementing the undertakings then given to D.S.I.R. by setting up new laboratories at Sheffield. The first full year of work under Mr. R. A. Haynes, the director of research, has been completed, and a report on progress showed considerably increased activity.

Protective Clothing

A new addition to their range of donkey jackets has just been introduced by **Jeltek Limited** (formerly the "Jeltek" division of J. E. Lesser and Sons Ltd.). This new garment, called the "Leatherjac," is manufactured from 30 oz. Blue Melton, has a Prussian storm collar, and is fitted with four buttons and two outside patch pockets. The supple chrome leather reinforcement covers the whole of the sleeves, the full length of the back, and over the shoulders to 6 in. down the front.

The generous leather reinforcements of this jacket offer considerable resistance to abrasion and hard usage, and will appeal to outdoor workers handling a varied range of materials. The makers state that this new garment will give long and lasting service under the most arduous working conditions.

Trade with Tunisia

According to an announcement in a recent issue of the Tunisian Journal Officiel, copper sulphate may be imported into Tunisia duty-free until December 31, 1958, up to a limit of 700 metric tons.

Barrel Finishing

At the Production Exhibition, held in London recently, one of the most interesting exhibits was that made by **Almco Supersheen Division of Gt. Britain Ltd.,** who showed barrel finishing under actual process production conditions. Full work load batches were to be seen being processed several times daily, so that observers could witness the full sequence of precision barrel finishing, from the loading of the media and parts, compound charging, how the sequential use of different compounds can produce, from a matte finish, polished or highly burnished surface finishes to suit the users' final finish requirements—painting or plating.

Features of Almco Supersheen barrelling equipment which are emphasized are that they are fitted with the Almco Varigear drive unit, with fingertip control, which affords infinitely variable speed range from 6 to 30 r.p.m., the electrical control gear which incorporates forward and reverse rotation of the barrel, stop button, process timer which can be pre-set to start and stop the machine over a period of 48 hr.; when the roll-away front guard is in an open position, barrel can only be "inched." This facility, as well as being a safety factor, also allows for extremely close control when emptying and cascading parts and media for separation after processing.

Filter Glasses

New aids to assist welding firms to choose the correct types of protective filter glasses for their operatives have been devised by the Smethwick firm of **Chance Brothers Ltd.** They are cards and wallets containing samples of seven Protex glasses for electric welding and eight Protal and Protex glasses for gas welding with and without flux. All conform to British Standard specifications.

With them it is easy to decide which filter is the most suitable for a particular job, by trying out a selection under working conditions. We understand that these cards are available free on application to suppliers of welding protection equipment.

A Civic Visit

Although **Mastermet Products Ltd.,** of Harrow, Middx., has only been operating since the latter part of last year, considerable success has already been achieved by this company, who were hosts

to the Mayor and Mayoress of Harrow and members of the Harrow Council recently. The visit was the occasion of the birthday of the company and was arranged to show the civic party the progress made by the company and by its parent company, **Adams Bros. and Burnley Ltd**, whose plant of nearly three acres is situated in Harrow, Middlesex.

The visitors commenced their tour of the works at the goods inwards store, then proceeding through the tool room to the press shops, where they were able to see a 400 tons press in action. Arriving eventually at the fabricating shops and assembly bays, the visitors saw the work of completion of various productions and, finally, a demonstration of the new electrostatic paint spraying plant was given. At the conclusion of their visit, the Mayor and his party were entertained to luncheon by the company.

News from Cannings

We understand from **W. Canning and Company Ltd.** that they have recently concluded an agreement with the Harper Buffing Machine Company, of Connecticut, U.S.A., relating to the manufacture of Uniflex polishing machines. The Uniflex is reputed to be the most modern design in polishing machines available to industry, and is extremely flexible in relation to the types of mass production polishing to which it can be adapted.

These units are being manufactured in the Birmingham works of W. Canning and Co., and they are available to industry generally as additional machines to the existing range of the company's polishing machines. The main features of the Uniflex unit are as follows:—

(1) Straight line travel of conveyor under polishing heads; (2) positive calibration of all machine settings; (3) polishing heads fitted with dual mops—thus increasing time of contact between mops and work without increasing the total polishing time; (4) omni-directional movement of workpiece—increases flexibility and ability to polish awkward shapes; (5) sectional form of construction—enables machines to be increased or decreased in size with a minimum of delay.

The British company has acquired world selling and patent rights (except for the U.S.A. and Canada) for these machines. At the same time, the company is now developing applications in the use of liquid composition spray, and a new technique using a quick-drying spray abrasive.

Change of Address

As from last week, the offices and showrooms of the North-East region of **Philips Electrical Ltd.** are located at 72 Wellington Street, Leeds, 1. The trade counter and stores have also moved to adjacent premises at 2 Britannia Street, Leeds, 1.

A Birmingham Event

On Wednesday of last week, the **Bronx Engineering Company Ltd.** held a film and reception at the Midland Hotel, Birmingham. The film showed the diverse uses of the company's wide range of press brakes—from 20 to 700 tons—pressings of steel and non-ferrous sections for all industrial purposes, the smaller with particular application to domestic appliances and the larger on pressings of ½ in. steel plate for heavy industry, including earth-moving equipment.

Some two hundred visitors were present at this event and exhibited great interest in the film, which was made for the company in Birmingham.

Scottish Representation

After a long association with James Ferguson and Munro Ltd., **Evershed and Vignoles Ltd.** have decided, as a matter of policy, to terminate the agency and to have direct representation in Scotland. The Scottish area office is situate at 13 Rutland Street, Edinburgh, 1, and is under the management of Mr. R. M. Wardrop, B.Sc., who joined the company as an instrumentation engineer in 1955.

International Nickel Award

Made annually, the second International Nickel Company of Canada Limited Award in Journalism was made recently to Mr. T. S. Green, of Beccles, Suffolk, a Cambridge University graduate who is studying in Canada under a Rotary International Scholarship. The Inco award consists of a specially-designed plaque—replica of a larger plaque which hangs permanently at the University of Western Ontario—and a reflex camera.

Made of nickel-plated copper and black-stained green oak, both plaques are inscribed with the Kipling quotation: "I keep six honest serving men; they taught me all I knew." Mr. Green, to whom the award has been made this year, achieved the highest standing in the graduate course in journalism at the University of Western Ontario.

Metal Finishing

Three years ago, **B. O. Morris Ltd.**, makers of the "Morrisflex" range of polishing shop and metal finishing equipment, commenced to manufacture under licence in this country the noted Hammond Automatic polishing machines of America. The company, which has now become recognized as one of the leading authorities on fully- and semi-automatic polishing, have carried out installations in a number of firms which specialize in quantity production. We understand that these installations are operating with outstandingly satisfactory results. The company is constantly extending its activities in this important field.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 18,832 tons, comprising London 5,887, Liverpool 11,755, and Hull 1,190 tons. Copper stocks totalled 15,622 tons, comprising London 9,939, Liverpool 5,358, Birmingham 150, and Swansea 175 tons.

The Standards Engineer

Conviction that the standards engineer would ultimately emerge as a key figure in industry was apparent throughout the fourth conference, held recently in London, of engineers and others concerned with the application of standards techniques. In an opening speech, Mr. F. J. Erroll, Parliamentary Secretary to the Board of Trade, established the keynote of the occasion by defining standards engineers as "the people who put standards to the test and make them effective in influencing the economy."

A progress report by the joint organizing committee of the B.S.I. and the Institution of Production Engineers dealt with what had been done in the past year to promote knowledge and application in industry of the "three S's"—standardization, simplification and specialization—and revealed that the B.S.I. is to produce a booklet describing the preparation and status of British standards and how far they conform with international standards.

In a Paper presented by Sir Stanley Rawson was pointed out the need for British industry to take a more dynamic part in the drafting of international standards. The author said that Britain was becoming increasingly dependent on the export of goods incorporating a high degree of technical competence. Other Papers were presented and discussed, and the final session of the conference once again turned to the role of the standards engineer. Subsequent discussion re-emphasized the urgent need for, and importance of, better training on standards matters.

The Z.D.A.

An interesting little booklet, well illustrated, has just been published giving a review of the services of the **Zinc Development Association** in 1957. It is stated that there are now some 250 firms in the Z.D.A. and the membership continues to expand, reflecting the growing appreciation of the services that the association provides.

Membership of the association and its affiliates is open to all suitably established firms in the zinc producing and using industries. The services provided to members are fully set out in the booklet, and details of the various technical publications produced.

Japanese Metal Output

News from the Japan Mining Association states that the output of non-ferrous metals in Japan during April decreased sharply, owing to strikes in the electrolysis section of the metal workers' union in support of their demand for a rise in wages. The decrease was most sharply marked in electrolytic lead and electrolytic zinc.

Output of electrolytic copper, lead, electrolytic zinc and distilled zinc in April was as follows (all in metric tons): electrolytic copper, 7,724; electrolytic lead, 3,137; electrolytic zinc, 4,252; distilled zinc, 4,116.

Shell Moulding Resin

We are informed by **Omni (London) Limited** that they are the sole United Kingdom distributors of the Durez range of resins. These resins are products of the United States, and are being increasingly used there. Full details of these, with samples and prices, may be obtained on application to the British distributors at 35 Dover Street, London, W.1.

Overseas Visitors

As part of a study tour of British industry organized by the Industrial Welfare Society, a group of six personnel executives from abroad—two Nigerians, two Iraqis, a Briton from Iraq and a Briton from British Guiana—will be visiting the **Glacier Metal Company Ltd.** at Wembley.

This eight-week tour is one of a series of "group tutorials" developed by the Industrial Welfare Society to foster the exchange of experience between executives from different countries by giving them an insight into personnel, welfare and training schemes operating in the more progressive organizations in Britain.

Metal Market News

COPPER was much encouraged last week by the good tone on Wall Street, and by the strength of the New York futures market, which prompted the custom smelters to put their price up by a further 25 points to 24½ cents. It appears that they were doing good business at 24¼ cents and, with scrap increasingly scarce and dear, a decision was reached to raise the quotation. Vague rumours have been current that one of the big producers might advance beyond 25 cents, but with business so bad this seems unlikely. On Convex, trading was again extremely active, and certainly in excess of the volume of business passing in Whittington Avenue. In the circumstances it was not surprising that standard copper advanced here, and by midweek the three months' quotation had climbed as high as £188 5s. 0d., but at the afternoon session values eased off somewhat. On Wednesday the New York market boiled over somewhat and this was reflected on the following day in London when, at the morning session, the forward position was traded down to £187 5s. 0d. Nevertheless, the tone of the market remained remarkably steady, and there is really no indication of any downward slide developing at the present time. It was reported last week that some good business had been done with the Continent and doubtless a certain amount of business was passing with consumers in this country. However, things fell away subsequently and conditions were very quiet at the end of the week. The continuation and extension of the dock strike has, in some cases, made matters difficult for those having metal to deliver ex ship London. Warehouses have also been affected.

The turnover in standard copper, including business done on the Kerb last week, must have exceeded 10,000 tons, Friday being a particularly active day. Closing at the best on Friday afternoon last, cash registered a gain of £5 10s. 0d., and three months of £5, the contango narrowing to £2 10s. 0d. On Friday afternoon's Kerb, £189 was paid in brisk trading, the firm tone being apparently due to news of a further advance of 25 points in the custom smelters' price to 24¾ cents. Throughout the week there has been a feeling that every day would see the end of the rise and some sort of a reaction but this, apart from the modest setback mentioned above, failed to occur and, indeed, it almost seems as though copper were destined to rise considerably further. There seems little doubt that Britain has secured large orders for copper wire for Russia, the total, according to an American report, being estimated at 50,000 tons. Experienced market observers profess themselves as somewhat anxious about the outlook for copper, since they feel that the American situation, at any rate, hardly justifies the kind of rise we have had. There is certainly now a speculative flavour about it, which is sufficient reason for nervousness, and the setback in midweek was a demonstration of how profit taking can affect a market. Stocks of copper fell by 330 tons to 16,477 tons.

The other metals were all very firm, although not particularly active. Tin, with a turnover of 1,250 tons, closed 10s. higher for cash at £731, and it is probable that not much floor support was necessary by the Council. The forward position was in demand and rose by £2 10s. 0d. to £736. In lead, only about 2,700 tons changed hands, June closing 17s. 6d. up and September £1 better. June 5 saw a reduction of ½ per cent in the U.S. price to 11 cents. Although consumer demand for zinc in the U.K. is said to be poor, there was a turnover of 4,000 tons, June closing 12s. 6d. up at £62 7s. 6d. and September 7s. 6d. better at £62 15s. 0d.

New York

Custom smelter activity in copper was the feature of the past week. Custom smelters raised their price half a cent a lb. in two successive quarter cent advances to 24½ cents a lb. Their sales were brisk, and, finding scrap intake limited by the lessened supply of new scrap, they were compelled to raise their electrolytic price and thus indirectly keep in check their sales. With but half a cent separating the custom smelters' price and the producer price of 25 cents, traders said that a test of demand should soon ensue. Some keen observers said that because of the cheaper price, a good part of producer former sales are going to the custom smelters, with fabricators apparently buying in slightly heavier volume at a good price, possibly partly replenishing their run-down stocks before the summer doldrums set in. Also, on July 1, a 1·7 cents a lb. copper tariff duty is to be imposed. Producers meanwhile reported a slightly better interest from fabricators, with brass mills buying a little more actively.

Scrap copper was firmer with offerings at best moderate. Another major U.S. copper mine cutback was announced during the week. Anaconda Company, of the "Big Three" U.S. producers, reported it was cutting back output in Montana by an additional ten per cent, or around 1,000 tons a month. U.S. copper producers, trade sources estimated, have ordered cutbacks in production since the beginning of 1958 of over 17,500 tons a month because of the slump in demand and the sharp drop in prices. Because the cuts were made at various times, not all of them have been reflected as yet in the supply picture.

Lead demand continued quiet, with the price continuing at 11½ cents per lb. New York. Industry sources estimated that Government stockpilers took about 9,000 tons of lead in their final monthly request for offers of U.S. metal under a purchase programme that began in mid-1954.

Vienna

Austrian copper ore and antimony ore production dropped during the first quarter of 1958 compared with the corresponding period of 1957, while production of lead-zinc ore, graphite, magnesite and bauxite rose. Copper ore production, according to official figures, was 41,213 metric tons, a drop of 2 per cent compared with the 1957 first-quarter production, and antimony ore production was 2,867 tons, a fall of 4·6 per cent.

Lead-zinc ore production was 44,852 tons, an increase of 14·7 per cent, graphite, 5,055 tons, a 2 per cent rise, and bauxite 3,986 tons, a 9 per cent rise.

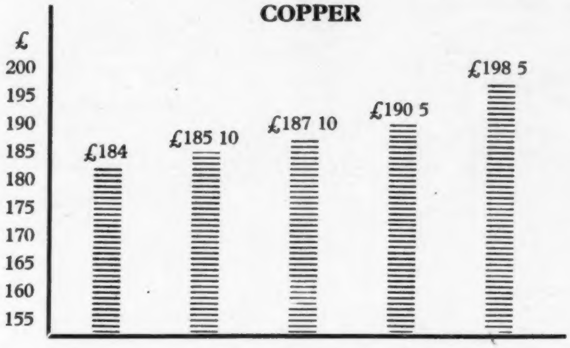
Birmingham

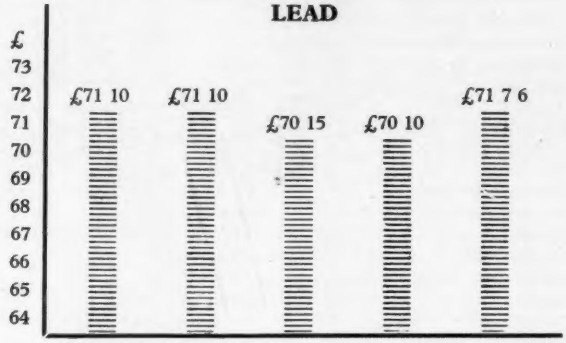
Conditions are fairly good in the Midland industrial towns. There has been some slight deterioration in some branches of engineering, but, on the whole, the outlook is satisfactory. It is significant that the number of unemployed in Birmingham itself has fallen slightly, according to the latest monthly figures. There are still vacancies for skilled workers in some industries. Having received some useful export orders, a local cycle firm which has been working a four-day week has returned to full-time. Manufacturers of heavy electrical equipment are busy on work for power stations and nuclear establishments, as well as contracts in connection with the electrification of parts of the British Railways' system. The local builders of rolling stock are busy on home and export work.

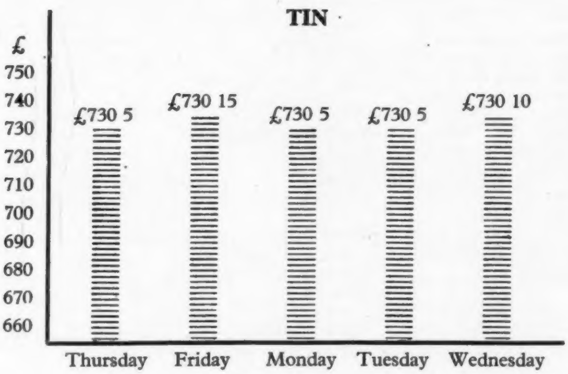
With regular production again in the motor trade, there is a steady flow of iron and steel products to the motor factories, where steady work is assured for a long way ahead. Financial restrictions have slowed down the placing of contracts for constructional engineering work, and the outlook is not good. Re-rollers continue to operate below capacity, due to lack of business in small steel bars. The time required for delivery of nearly all products, whether iron or steel, has been shortened, due to the combined effect of bigger output from more modern mills and a decline in new business.

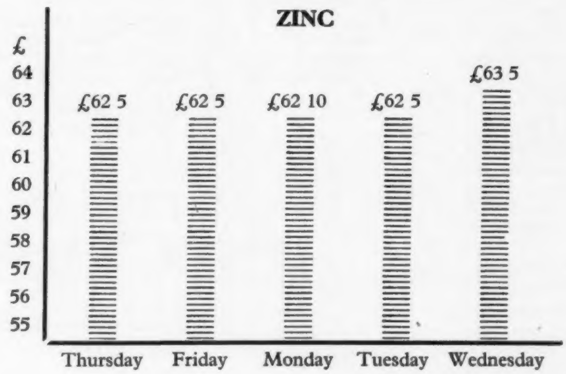
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 5 June 1958 to Wednesday 11 June 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.10	208 17 6
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,400	1,218 0					155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							370	214 12 6				
Electrolytic	26.25	191 17 6	24.24	200 5	235	204 10			2.30	192 7 6	25.00	200 0
Lead			10.50	86 15	110	95 15	178	103 5	.93	77 15	11.00	88 0
Magnesium												
Nickel			71.50	590 10	1,205	1,048 7 6	1,330	771 10	7.80	652 5	74.00	592 0
Tin	102.75	751 2 6			915	796 0	1,400	812 0	8.60	719 2 6	95.00	760 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	155	90 0	.82	68 10	11.25	90 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 11/6/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	198	5	0
Fire Refined 99·70%	„	197	0	0
Fire Refined 99·50%	„	196	0	0
Copper Sulphate	„	66	0	0
Germanium	grm.		—	
Gold	oz.	12	9	5½
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	71	7	6
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	76	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	6	10	0
Platinum	„	25	0	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	3½
Tellurium	lb.		15	0
Tin	ton	730	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	63	6	3
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	88	6	3
Granulated 99·99+%	„	100	18	9

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloy (Secondary)				
B.S. 1490 L.M.1	ton	151	0	0
B.S. 1490 L.M.2	„	158	0	0
B.S. 1490 L.M.4	„	179	0	0
B.S. 1490 L.M.6	„	195	0	0

†Average selling prices for April

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton	193	0	0
BSS 1400 AB.2	„	202	0	0
***Brass**				
BSS 1400-B3 65/35	„		—	
BSS 249	„	131	0	0
BSS 1400-B6 85/15	„	165	0	0
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	156	0	0
(86/7/5/2)	„	165	0	0
(88/10/2/1)	„	215	0	0
(88/10/2/½)	„	225	0	0
Manganese Bronze				
BSS 1400 HTB1	„	164	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	245	0	0
Phosphor Copper				
10%	„	212	0	0
15%	„	220	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	344	0	0
Grade D Plumbers	„	278	0	0
Grade M	„	377	3	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9	„		—	
Zinc Alloys				
Mazak III	ton	94	3	9
Mazak V	„	98	3	9
Kayem	„	104	3	9
Kayem II	„	110	3	9
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8
Sheet 18 S.W.G.	„		2	10
Sheet 24 S.W.G.	„		3	1
Strip 10 S.W.G.	„		2	8
Strip 18 S.W.G.	„		2	9
Strip 24 S.W.G.	„		2	10½
Circles 22 S.W.G.	„		3	2
Circles 18 S.W.G.	„		3	1
Circles 12 S.W.G.	„		3	0
Plate as rolled	„		2	7½
Sections	„		3	1½
Wire 10 S.W.G.	„		2	11
Tubes 1 in. o.d. 16 S.W.G.	„		4	0

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	0½
Sheet 18 S.W.G.	„		3	3
Sheet 24 S.W.G.	„		3	10½
Strip 10 S.W.G.	„		3	0½
Strip 18 S.W.G.	„		3	2
Strip 24 S.W.G.	„		3	10
BS1477 HP30M. Plate as rolled	„		2	10½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	6½
Sheet 18 S.W.G.	„		4	0½
Sheet 24 S.W.G.	„		4	10½
Strip 10 S.W.G.	„		3	9½
Strip 18 S.W.G.	„		4	0½
Strip 24 S.W.G.	„		4	8
BS1477. HPC15WP. Plate heat treated	„		3	5½
BS1475. HG10W. Wire 10 S.W.G.	„		3	9½
BS1471. HT10WP. Tubes 1 in. o.d. 16 S.W.G.	„		4	11
BS1476. HE10WP. Sections	„		3	1
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	6¼
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„		—	
Extruded Bar	lb.		1	8⅞
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	151	0	0
Condenser Plate (Naval Brass)	„	168	0	0
Wire	lb.		2	3⅜
Copper Tubes	lb.		1	10⅛
Sheet	ton	217	5	0
Strip	„	217	5	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	234	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	2¾
Lead Pipes (London)	ton	112	0	0
Sheets (London)	„	109	15	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	„		3	3
Wire 10%	„		3	9¾
Phosphor Bronze				
Wire	„		3	7⅝
Titanium (10,000 lb. lots)				
Billet 11″-4″	lb.	69/-	60/-	
Wire ·315″-·036″	„	101/-	201/-	
Sheet (4′/8′ × 2′) ·160″-·010″	„	100/-	158/-	
Strip ·048″-·003″	„	100/-	350/-	
Tube Representative gauge	„	320/-		
Extrusions	„	137/-		
Zinc Sheets, English destinations	ton	96	10	0
Strip	„		nom.	

Financial News

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for March, 1958, have been issued by the Ministry of Supply as follow (in long tons):—

Virgin Aluminium	
Production	2,819
Imports	17,049
Despatches to consumers	18,847
Secondary Aluminium	
Production	9,983
Virgin content of above	1,100
Despatches (including virgin content)	10,145
Secondary in Consumption (per cent)	
Wrought products	5·2
Cast products	82·5
Destructive uses (aluminium content irrecoverable)	55·7
Total consumption	28·8
Scrap	
Arisings	12,990
Estimated quantity of metal recoverable	9,035
Consumption by:	
(a) Secondary smelters	11,633
(b) Other users	1,114
Despatches of wrought and cast products	
Sheet, strip and circles	11,174
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,434
(b) Tubes (i) extruded	227
(ii) cold drawn	426
(c) (i) Wire	1,718
(ii) Hot rolled rod (not included in (c) (i)	48
Forgings	363
Castings: (a) Sand	1,739
(b) Gravity die	3,865
(c) Pressure die	1,587
Foil	1,923
Paste	223
Magnesium Fabrication	
Sheet and strip	6
Extrusions	37
Castings	153
Forgings	1

Offer to Stockholders

The Metal Industries Group has decided to dispose of its entire holding of £1·5 million Ordinary stock in The British Oxygen Company Ltd. The reason for the decision to sell, states the chairman of the company, is that it is the policy of the board to expand the group's interests as and when suitable opportunities occur, and it is considered desirable that the company's funds should be held in a readily available form.

The B.O.C. stock will be priced at 30s. free of stamp, per £1 unit, which is below the current market quotation, and offered to Metal Industries' Ordinary stockholders on a one-for-three basis. Both Preference and Ordinary stockholders will have the opportunity of applying for shares remaining after all acceptances have been received.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Hugh Girvan and Co. Limited (601471), 517 Salisbury House, London Wall, E.C.2. Registered March 27, 1958. To carry on business of agents in connection with the exporting, importing, buying and selling of steel, iron, copper, etc. Nominal capital, £100 in £1 shares. Directors: Hugh Girvan and Russell B. Girvan.

Northern Metals (Manchester) Limited (601566), Silver Street, Miles Platting, Manchester. Registered March 28, 1958. Nominal capital, £100 in £1 shares. Directors: Ian Major, Gordon H. Alder and Leslie G. Travers.

Elpu Products Limited (601621), 97a Baker Street, Sparkhill, Birmingham. Registered March 28, 1958. To take over business of a manufacturer of metal pressings and press tools carried on as "Elpu Products" at Sparkhill, Birmingham, etc. Nominal capital, £2,000 in £1 shares. Directors: Percy T. Gem and Mrs. Harriet C. Gem.

Trade Publications

Foundry Practice. — Foundry Services Ltd., Long Acre, Nechells, Birmingham.

In the latest issue of "Foseco," the bulletin issued by this company, a number of notes on degassing developments are given, a short article dealing with the failure of gunmetal test bars, and another on cupola operation details. Other short notes on the activities of this company are also given.

Titanium Technology.—Imperial Chemical Industries Limited, Metals Division, P.O. Box 216, Birmingham, 6.

An addition to their existing contributions to titanium technology is described by this company in a new leaflet dealing with anodically protected titanium. Carrying a small impressed voltage, anodically protected titanium can now be considered for use in some of the most difficult situations with which chemical engineers are faced. This opens the way for the development of titanium equipment in which fully immersed parts can be protected by supplying current from heavy-duty batteries continuously trickle-charged. A protective potential is maintained irrespective of any temporary cessation of mains supply

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 10/6/58.

	£
Aluminium	
New Cuttings	140
Old Rolled	117
Segregated Turnings	90
Brass	
Cuttings	117
Rod Ends	115
Heavy Yellow	99
Light	94
Rolled	109
Collected Scrap	96
Turnings	108
Copper	
Wire	163
Firebox, cut up	163
Heavy	155
Light	150
Cuttings	163
Turnings	148
Braziery	128
Gunmetal	
Gear Wheels	158
Admiralty	158
Commercial	130
Turnings	125
Lead	
Scrap	63
Nickel	
Cuttings	—
Anodes	476
Phosphor Bronze	
Scrap	130
Turnings	125
Zinc	
Remelted	53
Cuttings	40
Old Zinc	30

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£165.7.6)	190
Heavy copper	(£161.0.0)	185
Light copper	(£139.5.0)	160
Heavy brass	(£104.10.0)	120
Light brass	(£69.12.6)	80
Soft lead scrap	(£59.2.6)	68
Zinc scrap	(£36.10.0)	42
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£193.2.6)	222
Heavy copper	(£193.2.6)	222
Light brass	(£139.5.0)	160
Zinc castings	(£65.5.0)	75
Tin	(£565.10.0)	650
Aluminium pans (98½ per cent)	(£117.10.0)	135
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£191.10.0)	330
Aluminium copper alloy	(£107.7.6)	185
Lead, soft, first quality	(£84.2.6)	145
Lead, battery plates	(£49.7.6)	85
Copper, first grade	(£174.0.0)	300
Copper, second grade	(£162.10.0)	280
Bronze, first quality machinery	(£177.0.0)	305
Bronze, commercial gunmetal	(£148.0.0)	255
Brass, heavy	(£124.15.0)	215
Brass, light	(£113.2.6)	195
Brass, bar turnings	(£121.17.6	210
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

THE STOCK EXCHANGE

Further Gains Not Held In Several Instances And Business Still On The Small Side

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 10 JUNE +RISE —FALL		DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	21/3	+9d.	10	10	9 8 3	21/3	17/9	28/3	18/-
400,000	2/-	Anti-Attrition Metal	1/6		4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	47/9xd		15	15	6 5 9	51/-	47/-	72/3	47/9
1,590,000	1	Birfield Industries	46/9	+6d.	15	15	6 8 3	53/9	46/3	70/-	48/9
3,196,667	1	Birmid Industries	68/-	+2/6	17½	17½	5 3 0	68/-	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	28/1½xd		10	8	7 2 3	28/6	23/9	33/-	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/4½		5	5	6 10 0	15/7½	14/7½	16/-	15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/7½		6	6	7 4 3	17/-	16/6	19/-	16/6
500,000	1	Bolton (Thos.) & Sons	26/3		12½	12½	9 10 6	28/9	26/3	30/3	28/9
300,000	1	Ditto Pref. 5%	15/3		5	5	6 11 3	16/-	15/3	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/3		7	7	7 5 6	19/3	19/-	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	43/3	+1/9	12	12	5 6 0	46/6	37/-	72/-	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/-		6	6	6 6 3	19/3	18/4½	21/6	18/-
15,000,000	Stk. (£1)	British Insulated Callender's Cables	45/6	+2/-	12½	12½	5 10 0	45/6	38/9	55/-	40/-
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	33/-	—2/-	10	10	6 1 3	35/3	29/-	39/-	29/6
600,000	Stk. (5/-)	Canning (W.) & Co.	19/9		25+*2½C	25	6 6 6	21/-	19/9	24/6	19/3
60,484	1/-	Carr (Chas.)	2/-		25	25	X8 15 0	2/3	2/-	3/6	2/1½
150,000	2/-	Case (Alfred) & Co. Ltd.	4/3		25	25	11 16 3	4/9	4/1½	4/6	4/-
555,000	1	Clifford (Chas.) Ltd.	17/3	+3d.	10	10	11 12 0	17/3	16/-	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/10½		6	6	7 11 3	—		17/6	16/-
250,000	2/-	Coley Metals	2/10½		20	25	13 18 3	4/6	2/10½	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	44/3	+1/9	18¾	22½	8 9 6	51/6	42/6	92/6	49/-
1,136,233	1	Davy & United	50/-		15	12½	6 0 0	50/-	45/9	60/6	42/6
2,750,000	5/-	Delta Metal	19/-	+1½d.	30	*17½	7 18 0	21/4½	17/7½	28/6	19/-
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	31/6		12½	15B	7 18 9	33/-	24/-	38/6	25/-
750,000	1	Evered & Co.	28/3xcap	+3d.	15Z	15	7 1 6	28/3	26/-	52/9	42/-
18,000,000	Stk. (£1)	General Electric Co.	31/3	+1/3	12½	14	Y7 7 3	38/7½	29/6	59/-	38/-
1,250,000	Stk. (10/-)	General Refractories Ltd.	31/9	—6d.	20	17½	6 6 0	33/9	27/3	37/-	26/9
401,240	1	Gibbons (Dudley) Ltd.	65/-xd	+3d.	15	15	4 12 3	66/3	64/-	71/-	53/-
750,000	5/-	Glacier Metal Co. Ltd.	6/6		11¼	11¼	8 17 0	6/6	5/7½	8/1½	5/10½
1,750,000	5/-	Glynwed Tubes	13/7½	+3d.	20	20	7 6 9	13/7½	12/10½	18/-	12/6
5,421,049	10/-	Goodlass Wall & Lead Industries ...	23/3xd	+3d.	13‖	18Z	5 11 9	23/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	46/9		17½	17½	7 9 9	46/10½	45/-	50/-	46/-
396,000	5/-	Harrison (B'ham) Ord.	12/3	+1½d.	*15	*15	6 2 6	12/4½	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9xd		7	7	7 9 3	19/-	18/9	22/3	18/7½
1,075,167	5/-	Heenan Group	7/3		10	20‡	6 18 0	7/7½	6/9	10/4½	6/9
142,045,750	Stk. (£1)	Imperial Chemical Industries ...	44/3		12Z	10	5 8 6	44/10½	36/6	46/6	36/3
33,708,769	Stk (£1)	Ditto Cum. Pref. 5%	16/1½xd		5	5	6 4 0	17/1½	16/-	18/6	15/6
14,584,025	**	International Nickel	142½	+1½d.	$3.75	$3.75	4 15 0	144½	134	222	130
430,000	5/-	Jenks (E. P.), Ltd.	8/3		27½ϕ	27½	8 6 9	8/3	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/-	17/-	14/6
3,987,435	1	Ditto Ord.	44/-		10	9	4 11 0	44/6	37/6	58/9	40/-
600,000	10/-	Keith, Blackman	15/-	—1/3	15	15	10 0 0	16/3	15/-	21/9	15/-
160,000	4/-	London Aluminium	3/7½	+1½d.	10	10	11 0 9	4/3	3/-	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	43/3	—3d.	12½	12½	5 15 9	43/9	39/9	54/6	41/-
400,000	1	Ditto Pref.	23/3	+6d.	7½	7½	6 9 0	23/3	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	32/6		15	15	9 4 6	35/-	32/-	48/9	37/6
1,530,024	1	Ditto A Ord.	31/3		15	15	9 12 0	32/6	30/-	47/6	36/-
1,108,268	5/-	Manganese Bronze & Brass	9/6		20	27½‡	10 10 6	10/6	9/-	21/10½	7/6
50,628	6/-	Ditto (7½% N.C. Pref.)	6/-		7½	7½	7 10 0	6/3	5/9	6/6	5/-
13,098,855	Stk. (£1)	Metal Box	51/6	+2/3	20‡	15M	3 17 9	51/6	41/9	59/-	40/3
415,760	Stk. (2/-)	Metal Traders	7/-		50	50	14 5 9	7/-	6/3	8/-	6/3
160,000	1	Mint (The) Birmingham	20/-		10	10	10 0 0	22/9	20/-	25/-	21/6
80,000	5	Ditto Pref. 6%	81/6		6	6	7 7 6	83/6	81/6	90/6	83/6
3,064,930	Stk. (£1)	Morgan Crucible A	38/6		10	11	5 4 0	40/-	34/-	54/-	35/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/-		5½	5½	6 9 6	17/3	17/-	19/3	16/-
2,200,000	Stk. (£1)	Murex	55/3	+3d.	20	20	7 4 9	57/6	53/3	79/9	57/-
468,000	5/-	Ratcliffs (Great Bridge)	8/3	+1/-	10	10	6 1 3	8/3	6/10½	8/-	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	25/9xd	+1/7½	20	27½D	7 15 3	27/-	25/6	41/-	24/9
1,365,000	Stk. (5/-)	Serck	12/6xd	+3d.	17½Z	15	4 13 3	12/7½	11/-	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	47/6	+3/9	16	16	6 14 9	47/6	43/9	57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	19/6	—6d.	6½	6½	6 13 3	20/9	19/6	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	55/9	+1/-	15	15	5 7 9	55/9	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	29/1½	—10½d.	10	10	6 17 3	32/6	29/1½	46/-	29/-
750,000	Stk. (£1)	Ditto Pref. 5%	15/-		5	5	6 13 3	15/6	14/9	18/-	14/-
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/3		*5	*5	7 4 9A	23/-	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	75/3	+6d.	20	15	5 6 3	76/3	70/9	83/-	64/-
2,666,034	Stk. (£1)	Westinghouse Brake	39/6	+6d.	10	18P	5 1 3	39/6	32/6	85/-	29/1½
225,000	2/-	Wolverhampton Die-Casting ...	7/1½	—3d.	25	40	7 0 3	8/-	7/1½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	17/3		27½	27½	7 19 6	17/7½	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/6		20	17½E	14 5 9	3/9½	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	—		12/6	11/3
150,000	1/-	Zinc Alloy Rust Proof	2/10½		40D	33¼	9 5 6	3/1½	2/7½	5/-	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized Issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. M and 10% capitalized issue. Y Calculated on 11¼% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/- per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.